L Number	Hits	Search Text	DB	Time stamp
1	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	monitor$4 with expos$5 and electron and imag$5 and detect$4	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	[illegible]
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[illegible]	[illegible]	monitor$4 with expos$5 and electron and imag$5 and detect$4 and pattern and detect$5 with dimension$4 or width or length	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	[illegible]
[illegible]	[illegible]	monitor$4 with expos$5 and electron and imag$5 and detect$4 and pattern and detect$5 with dimension$4 or width or length and mem$4	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	[illegible]
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43	81	monitor$4 with expos$5 and electron and imag$5 and detect$4 and pattern and detect$5 with dimension$4 or width or length and mem$4 and [illegible] and calculat$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/21 12:44
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L Number	Hits	Search Text	DB	Time stamp
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4.1	.4	electron and secondary near1 portion and monitor$3 and model$3 and characteristic or critical near dimension$3 and imag$5 and cpu or computer or memor$4 or processor and detect$4 and focus	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	[illegible]
406	247	electron and second and monitor$3 and model$3 and characteristic or critical near dimension$3 and imag$4	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	[illegible]
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[illegible]	[illegible]	monitor$3 with (focus or exposure) and electron and imag$4 and (CPU or computer or calculat$4) and resist) and width and imag$4) and (critical or characteristic) near dimension$4) and monitor$3 near3 focus) and [illegible]$4	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/24 11:5[illegible]
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[illegible]	[illegible]	[illegible] electron near beam [illegible] and detect$4 with electron [illegible] and imag$4 and calculat$4 and SEM and memor$4 [illegible] and focus and exposure [illegible] and correct$4 [illegible] and cpu [illegible] computer [illegible] and width [illegible] and pattern [illegible] and resist	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	[illegible]
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[illegible]	[illegible]	[illegible] with [illegible] beam and detect$4 with electron and imag$4 [illegible] exp[illegible]	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	[illegible]
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                  dimension$4
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                  exposure and imag$4 and electron and
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                  characteristic near dimension$4
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                                                                        [illegible];
                                                                        DERWENT;
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[illegible]	[illegible]	manifold and reservoir and ion and [illegible] and liquid and [illegible] nozzle near manifold	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	[illegible]

PATENT ABSTRACTS OF JAPAN

(11)Publication number : **11-307431**
(43)Date of publication of application : **05.11.1999**

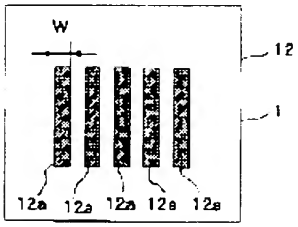
(51)Int.Cl.
H01L 21/027
G03F 7/20
H01L 21/3205

(21)Application number : **10-113597**
(22)Date of filing : **23.04.1998**
(71)Applicant : **SONY CORP**
(72)Inventor : **KAMIYA MASAYUKI**

(54) MANUFACTURE OF SEMICONDUCTOR DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To achieve exposure of a wire pattern having a target width, by detecting a fluctuation amount of a focus position in accordance with a difference between widths of two wire patterns, and detecting a fluctuation amount of an exposure amount in accordance with a difference between a width of at least one of the wire patterns and a predetermined width of a wire.
SOLUTION: As a management pattern 1, a first management pattern 12 is provided, in which wire patterns 12a are densely exposed with regular spaces, and a second management pattern is provided, in which wire patterns are roughly exposed. As in the case of the first and second management patterns, when sensitivity fluctuates due to different wire patterns, a width of a wire is not affected. However, when a focus changes, an error appears in a width of a wire. Therefore, by using the error, a correction amount is fed back to exposing conditions. Namely, in order to correct fluctuation of a wire width of the wire pattern, a focus and or exposure amount is controlled so as to correct an error of a wire width of the wire pattern.



LEGAL STATUS
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[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the manufacture method of a semiconductor device of exposing the circuit pattern which forms the circuit decided beforehand. for example to a semiconductor substrate. and manufacturing a semiconductor device.
[0002]
[Description of the Prior Art] It is built in electronic equipment and IC (Integrated Circuit) as a semiconductor device which has an electronic circuitry serves as existence indispensable to a miniaturization and advanced features of electronic equipment today. After IC's exposing the exposure pattern for exposing the circuit decided beforehand to the semiconductor substrate which makes silicon etc. the quality of the material and forming a circuit pattern. IC is manufactured through predetermined processes. such as a development process. in order to make the wiring width of face aiming at the wiring width of face of a circuit pattern. it is necessary in formation of this circuit pattern to feed back the focal position (henceforth a focus (Focus)) as a distance to the semiconductor substrate changed at the time of manufacture. and the amount of amendments of the amount of sensitivity change (the following and sensitivity -- for example. light exposure -- an amendment -- for it to consider as an amendment thing by things) to an aligner. and to let exposure conditions be the optimal things.
[0003] In order to determine the exposure conditions for exposing the circuit pattern which constitutes a circuit as the conventional exposure method. before manufacturing IC as a product. the method of performing test sample exposure is taken. the work (the following and "-- condition appearance is carried out and it is called ") which computes the optimal amount of amendments by computing the focus and the amount of sensitivity change which were fluctuated while shifting gradually the focus and exposure energy (henceforth light exposure) of an aligner in advance was required of this method. Performing this condition **** in a manufacturing process had become the cause of inducing aggravation of TAT (Turn Around Time) with the increase in a man day.
[0004] Moreover. there is a method of not performing condition **** mentioned above as the another exposure method in order to avoid aggravation of TAT. By this method. exposure conditions are determined by predicting the exposure conditions of the semiconductor device which manages the inclination of sensitivity change and is manufactured by supervising the wiring (result) width of face after the light exposure for every lot manufactured in the past. and exposure of a circuit pattern.
[0005] Drawing 12 is a flow chart which shows the still more nearly another conventional exposure method. By the conventional exposure method. the exposure pattern which has a predetermined circuit pattern on a semiconductor substrate is exposed first (step ST 21). The wiring width of face of the exposed circuit pattern is measured (step ST 22). The error of the wiring width of face which should originally be exposed. and the actually exposed wiring width of face is detected. and a sensitivity gap is judged (step ST 23). If there is no sensitivity gap. (O.K.) end will be carried out (step ST 26). and amount of exposure amendments **E is computed from the error detected when there was a sensitivity gap (step ST 24). Light exposure is amended by this amount of exposure amendments **E (step ST 25).
[0006] from the light exposure pair wiring width-of-face property beforehand grasped in order to drive into the wiring width of face (target line breadth of drawing 14) made into the target in the circuit pattern after exposing when change of substandard wiring width of face is checked in management of the inclination of this sensitivity change (for example. lots 6 and 10 in drawing 11). if inclination management is performed according to the amendment by this exposure method -- since -- light exposure is computed And the correction value is fed back to an aligner. and exposure conditions are changed and it is coped with. Moreover. even if there was no substandard change in the wiring width of face of the circuit pattern after exposure. light exposure was rectifying to the fine amendment case by carrying out inclination management by measuring the wiring width of face of the manufactured semiconductor device.
[0007]
[Problem(s) to be Solved by the Invention] However. adoption of this exposure method generates a problem as management does not do the error of wiring width of face at all to change of a focus only by changing light exposure for an amendment reason but shows it below. Drawing 13 (A) shows the result wiring width-of-face property of the circuit pattern at the time of changing sensitivity and a focus simultaneously. the case where drawing 13 (B) is changed simultaneous [sensitivity and a focus] -- receiving -- light exposure -- an amendment -- the result wiring width-of-face property after an amendment of the circuit pattern at the time of corresponding only by things is shown

[0008] In drawing 13 (A) and drawing 13 (B), the direction of a horizontal axis shows a focus, and the direction of a vertical axis shows wiring width of face (line breadth). Although the **** pattern is driven into target line breadth in the amendment by the conventional exposure method of drawing 12 as shown in drawing 13 (B) as a result since it is an amendment of only light exposure **E, the dense pattern which is not managed will exceed a line breadth specification upper limit. Moreover, also about the sparse pattern which was able to be driven into target line breadth, since it continues being in the state which the focal gap generated, change of the property of focal pair wiring width of face is sharp, and it has great influence on the stability of the exposed wiring width of face.

[0009] The wiring width-of-face properties j and k are wiring width-of-face properties about the circuit pattern which is two from which the degree of high density of result wiring width of face differs. The wiring width-of-face property j shows a wiring width-of-face property in case a circuit pattern is **** arrangement, and the wiring width-of-face property k shows the wiring width-of-face property in the case of being dense arrangement. On the semiconductor substrate which constitutes a semiconductor device, the circuit pattern from which the degree of high density differs in fact is intermingled, and is arranged. Therefore, the property of wiring width of face over a focus changes with differences in the degree of high density of a circuit pattern.

[0010] If a circuit pattern crowds like drawing 5 (A) -> drawing 6 (A) -> drawing 7 (A) when the exposure pattern as an imprint pattern for exposing a circuit to a semiconductor substrate is exposed to a semiconductor substrate, a focal pair wiring width-of-face property will change to the property of the convex of facing down [property of a upward convex] gradually like drawing 5 (B) -> drawing 6 (B) -> drawing 7 (B), respectively.

[0011] As opposed to the position of the X-axis in the point of inflection of the wiring width-of-face property j being the focus F1 of an ideal state, when Focus F has shifted from the focus F1 as an ideal state like drawing 13 (A) The dotted line F of the direction of a vertical axis comes (difference **F of the focus F which shows this dotted line, and the focus F1 of the ideal state mentioned above is hereafter called "focal gap") to show the focus actually exposed by the manufactured main part of a product.

[0012] For this reason, in the **** wiring width-of-face property j and the dense wiring width-of-face property k, a difference will arise to the result wiring width of face after exposure. Even if amount of exposure amendments **E rectifies light exposure in this state, it is impossible to cancel the difference of the result wiring width of face by focal gap **F which the wiring width-of-face property k and the wiring width-of-face property j only changed up and down in the direction of a vertical axis (wiring cross direction) within the graph of drawing 13 (A), and was mentioned above

[0013] By this exposure method, only the property of the wiring width-of-face property j is managed like drawing 13 (B). For this reason, for after an amendment, the pattern of the wiring width-of-face property k is USL (it is hereafter used as an abbreviated name of a wiring width-of-face specification upper limit.). "LSL" -- as a wiring width-of-face specification lower limit -- using it -- there is also an example which exceeded, and became substandard and the defect of the manufactured product generated

[0014] Moreover, as another trouble of focal gap **F, it is the field W1 (the property j of a circuit pattern leans greatly) where the variation [as opposed to change of a focus as compared with the point of inflection of the ideal state mentioned above although the wiring width-of-face property j was driven into target line breadth like drawing 13 (B)] of wiring width of face is intense, and the stability of the wiring width of face of the circuit pattern exposed to change of a focus is spoiled. the above troubles -- change of Focus F and change of sensitivity -- dissociating -- an amendment -- the cause was not to make things

[0015] Then, without computing the optimal amount of amendments for exposing so that this invention may cancel the above-mentioned technical problem and it may become a size aiming at the wiring width of face of the circuit pattern of a semiconductor device in advance The circuit pattern of target wiring width of face is exposed by things, each change of a focal position and sensitivity -- separation detection -- carrying out -- exposure conditions -- an amendment -- It aims at offering the manufacture method of the semiconductor device which can expose the circuit pattern from which the inclination of a focal position and sensitivity is furthermore managed with a sufficient precision, and the degree of high density of a circuit pattern differs with a sufficient precision, and can improve the productive efficiency of a semiconductor device.

[0016]

[Means for Solving the Problem] It is the manufacture method of a semiconductor device of manufacturing a semiconductor device by rectifying and exposing exposure conditions in order to form in a semiconductor substrate the circuit pattern which constitutes the circuit decided beforehand, if the above-mentioned purpose is in this invention. Are arranged so that it may become a fixed interval, and change of the light exposure to a semiconductor substrate affects wiring width of face. The 1st exposure managed pattern which has the circuit pattern arranged so that change of the focal position at the time of exposing to a semiconductor substrate may not affect wiring width of face. The 1st step which exposes the 2nd exposure managed pattern which has the circuit pattern which is arranged at a different interval from the circuit pattern of the 1st exposure managed pattern, and is arranged so that each change of light exposure and a focal position may affect wiring width of face to a semiconductor substrate, the [the 1st management exposure pattern and] -- the [the 1st circuit pattern exposed with two management exposure patterns, and] -- with the 2nd step which measures the wiring width of face of the circuit pattern of each 2 circuit pattern the [the 1st circuit pattern and] -- with the 3rd step which detects the amount of change of a focal position based on the difference of the wiring width of face of each circuit pattern of 2 circuit patterns the [the 1st circuit pattern and] -- it is attained by the manufacture method of the semiconductor device characterized by having the 4th step which detects the amount of change of light exposure based on the difference of the wiring width of face of at least one circuit pattern of 2 circuit patterns, and the wiring width of face which should originally be exposed, and which was set up beforehand

[0017] It is the manufacture method of a semiconductor device of manufacturing a semiconductor device by rectifying and exposing exposure conditions in order to form in a semiconductor substrate the circuit pattern which constitutes the circuit decided beforehand from this invention. The 1st exposure managed pattern with which the circuit pattern after exposure is arranged at a fixed interval, change of the light exposure to a semiconductor substrate affects the wiring width of face of a circuit pattern, and change of the focal position at the time of exposing to a semiconductor substrate also affects wiring width of face. A circuit pattern is exposed at a different interval from the 1st exposure managed pattern, and the 2nd exposure managed pattern with which each change of light exposure and a focal position affects the wiring width of face of a circuit pattern is exposed to a semiconductor substrate. the [next,] -- the [one management exposure pattern and] -- the [the 1st circuit pattern exposed with two management exposure patterns, and] -- the wiring width of face of the circuit pattern of each 2 circuit pattern is measured the [and the 1st circuit pattern and] -- the error of a focal position is detected based on the difference of the wiring width of face of each circuit pattern of 2 circuit patterns the [moreover, the 1st circuit pattern and] -- the error of light exposure is detected based on the difference of the wiring width of face of at least one circuit pattern of 2 circuit patterns, and the wiring width of face which should originally be exposed and which was set up beforehand Each change of a focal position and sensitivity can be separated and detected, without this computing the optimal amount of amendments for exposing in advance so that it may become a size aiming at the wiring width of face of the circuit pattern of a semiconductor device.

[0018]

[Embodiments of the Invention] Hereafter, the gestalt of suitable implementation of this invention is explained in detail based on an accompanying drawing. in addition, since the gestalt of the operation described below is the suitable example of this invention, although desirable various limitation is attached technically, especially the range of this invention is not restricted to these gestalten, as long as there is no publication of the purport which limits this invention in a following discussion

[0019] As an outline of the method of manufacturing the semiconductor device (henceforth IC (IntegratedCircuit)) which carried the semiconductor integrated circuit, it is carried out as follows. First, the exposure pattern based on the specification determined beforehand by which layout design was carried out is created. This exposure pattern is imprinted by the aligner on a semiconductor substrate (henceforth Wafer WH) (exposure process). As for the circuit pattern on the exposed substrate, IC is manufactured through development etching process, an impurity diffusion process, a vacuum evaporationo process, and an assembly-inspection process.

[0020] Hereafter, the manufacture method (the exposure method in the exposure process mentioned above) of the semiconductor device as a desirable operation gestalt of this invention is explained. Drawing 1 is the plan showing signs that the semiconductor integrated circuit was formed on the semiconductor substrate. Drawing 2 is the plan showing an example which expanded the semiconductor integrated circuit formed on the semiconductor substrate of drawing 1 An "exposure pattern" shows the pattern of the circuit imprinted by the aligner on Wafer WH, by the following explanation, a "real circuit pattern" shows the pattern of one semiconductor integrated circuit on the wafer WH imprinted with the exposure pattern (henceforth an integrated circuit), and a "circuit pattern" shows 1 wiring of one of the pattern of the circuit imprinted or imprinted on Wafer WH by it. Moreover, or it is separated [from the "non-dense"] of adjacent circuit patterns, it shows that there is nothing, and it shows that the interval of the circuit pattern which adjoins "it is dense" is narrower than a **** circuit pattern.

[0021] An aligner exposes an integrated circuit 2 on the front face of Wafer WH based on predetermined exposure conditions. Since an aligner cannot expose all the integrated circuits 2 by one exposure on Wafer WH, it is divided and exposed to multiple times The one-shot pattern 4 shows the range of the real circuit pattern 6 exposed at a time by the aligner. This aligner is explained as what exposes four real circuit pattern 6 grades at a time like drawing 2 .

[0022] To the verification one-shot pattern 4 of the error of the wiring width of face (line breadth) by the roughness and fineness of arrangement of a circuit pattern, it has the scribe line 8 which makes boundaries, such as real circuit pattern [as one integrated circuit which constitutes the integrated circuit 2 on Wafer WH like drawing 2] 6, and real circuit pattern 6 comrades, and the managed pattern 1 The managed pattern 1 is a pattern which the wiring width of face of the circuit pattern after being exposed is measured, and is exposed auxiliary in exposure conditions at an amendment sake. The managed pattern 1 is exposed by the four corners of the one-shot pattern 4 so that one may not lap with the real circuit pattern 6 at the center of four and the one-shot pattern 4.

[0023] As a managed pattern 1, the 1st managed pattern 12 with which circuit pattern 12a is exposed, and the 2nd managed pattern 14 with which circuit pattern 14a is exposed by the non-dense like drawing 4 (A) are prepared, preparing a densely fixed interval, for example like drawing 3 (A) as at least two circuit patterns for an amendment Here, it reaches 1st managed pattern 12 and the 2nd managed pattern 14 shows each of which is arranged in the one-shot pattern 4 of drawing 2 as a managed pattern 1, respectively.

[0024] Like drawing 3 (A) in the 1st managed pattern 12, five circuit patterns are exposed so that circuit pattern 12a may hold a fixed interval, for example. The 1st managed pattern 12 is an exposure pattern with which circuit pattern 12a is exposed densely. The 1st managed pattern 12 changes exposure conditions, and is a focus (it is used below Focus as a term which shows the focal position as one of the exposure conditions) Moreover, the gap from the ideal state in this focus is called "focal gap". Even if it changes, wiring width of face becomes fixed like drawing 3 (B) On the other hand, when the 1st managed pattern 12 changes exposure conditions and sensitivity (it uses as what shows the exposure conditions which it is one of the exposure conditions, and are hereafter influenced with light exposure) is changed, wiring width of face shows the inclination of minus like drawing 3 (C).

[0025] One circuit pattern is arranged like drawing 4 (A) in the 2nd managed pattern 14 as an example of a managed pattern **** in arrangement of circuit pattern 14a. The 1st managed pattern 12 is arranged so that the arrangement interval of circuit patterns may become sufficiently large. If the 2nd managed pattern 14 changes the exposure conditions in the case of exposure and a focus is changed, wiring width of face will serve as an upper convex type parabola like drawing 4 (B). On the other hand, when the 2nd managed pattern 14 changes the exposure conditions in the case of exposure and sensitivity is changed, wiring width of face shows the inclination of minus like drawing 4 (C).

[0026] Although there is no influence in wiring width of face when it reaches 1st managed pattern 12, arrangement of a circuit pattern differs like the 2nd managed pattern 14, respectively and sensitivity is changed from having mentioned above, when a focus is changed, it turns out that wiring width of face produces an error. Then, in order to expose the circuit pattern of the wiring width of face by which the aligner was stabilized by making this amount of amendments feed back to the exposure conditions of an aligner using the error of wiring width of face arising by the difference in the roughness and fineness in arrangement of such a circuit pattern, it verifies about what managed pattern 1 should be adopted.

[0027] In order to choose suitable verification **** of a managed pattern, and the managed pattern 1 suitable as mentioned above, in order to manage wiring width of face, the pattern which serves as a candidate of the managed pattern 1 which is carrying out three arrangement different, respectively like drawing 5 (A), drawing 6 (A), and drawing 7 (A) is exposed, and a circuit pattern is made to form. The manufacture conditions at this time are set up as follows.

Aligner: KrF excimer stepper (NA:0.50, sigma:0.60)

Photoresist: SEPR-3404T (film pressure : 0.7 micrometers)

Wiring width of face of a line-breadth managed pattern (managed pattern): The exposure method of the semiconductor device as a desirable operation gestalt of this invention adopts 0.25 micrometers of two suitable managed patterns 1 from these three circuit patterns.

[0028] As for drawing 5 (A), arrangement of circuit patterns 16a, 16b, and 16c shows an example of the ****** 3 managed pattern 16 (the 2nd exposure managed pattern). Drawing 5 (B) shows the property of the wiring width of face of the 3rd managed pattern 16 of having changed the focus in exposure conditions. According to drawing 5 (B), change of wiring width of face is drawing a parabola which serves as a convex type to change of a focus. Here, the distance between the circuit patterns in the 3rd managed pattern 16 in which a property like drawing 5 (B) is shown is 0.27 micrometers.

[0029] Drawing 6 (A) shows an example of the 4th managed pattern 18 (the 1st exposure managed pattern) with dense arrangement of a circuit pattern. Drawing 6 (B) shows the property of the wiring width of face of the 4th managed pattern 18 changed in the focus in exposure conditions. According to drawing 6 (B), change of wiring width of face is fixed to change of a focus. Here, in order to show a property like drawing 6 (B), it is desirable that they are the following manufacture conditions, for example.

Light-exposure (sensitivity) change range: 40**4 mJ cm2 focus change range : Just Distance between Focus(proper focus)**0.4-micrometer circuit patterns : Change of wiring width of face presupposes again that it is 0.25**0.02 micrometers of definitions of things with the flat property of drawing 6 (B) **5% or less to the size (wiring width of face) of a line breadth managed pattern. The distance between the circuit patterns in the 4th managed pattern 18 is 0.25 micrometers.

[0030] Drawing 7 (A) shows an example of the 5th managed pattern 20 with very dense arrangement of circuit pattern 20a. Drawing 7 (B) shows the property of the wiring width of face of the 5th managed pattern 20 of having changed the focus by the aligner. According to drawing 7 (B), change of wiring width of face is drawing a parabola which serves as a convex type to change of a focus. Here, the distance between the circuit patterns in the 5th managed pattern 20 in which a property like drawing 7 (B) is shown is 0.23 micrometers.

[0031] The exposure method as the amendment method of the exposure conditions the above 3rd managed patterns 16 and for stabilizing wiring width of face by reaching 4th managed pattern 18 from each wiring width-of-face property of the 5th managed pattern 20 is explained. The following explanation adopts and explains the 3rd managed pattern 16 with which wiring width of face is not influenced, for example to change of a focus, but wiring width of face tends to be influenced to change of the 4th managed pattern 18 of ****, and a focus. In addition, although the 3rd managed pattern 16 was adopted in this explanation, it cannot be overemphasized that the 5th managed pattern 20 may be used instead.

[0032] There is amendment need about the error of the wiring width of face of a circuit pattern by controlling a focus and or light exposure for change of the wiring width of face of the exposed circuit pattern in the exposure conditions of an aligner to an amendment sake. Therefore, by the exposure method as a desirable operation gestalt of this invention, you have to distinguish whether a focus should be rectified for the error of the wiring width of face of a circuit pattern to an amendment's, or whether light exposure's being rectified for sensitivity to an amendment sake and both should be used together and rectified.

[0033] Distinction drawing 8 of the cause of an error in the wiring width of face of the exposed circuit pattern shows the result which measured the value which equalized the wiring width of face of the circuit pattern for every lot at the time of manufacturing IC by the aligner. By drawing 8 , a horizontal axis shows each batch number, and the vertical axis shows the wiring width of face for every lot by it. By this explanation, the target line breadth of a vertical axis shows the wiring width of face made into the target of the circuit pattern to expose. USL shows a wiring width-of-face specification upper limit by it.

and LSL shows a wiring width-of-face specification lower limit by it

[0034] In drawing 8 , it turns out that it is substandard by the batch number 6 and the batch number 10. In a batch number 6, it reaches 3rd managed pattern 16 and it turns out that the 4th managed pattern 18 is the almost same variation in wiring width of face. Since the sensitivity which reaches 3rd managed pattern 16 and affects the wiring width of face of both 4th managed patterns 18 is not suitable as mentioned above, this is produced. that is. -- this batch number 6 -- the exposure conditions of an aligner -- setting -- light exposure ** E minutes -- an amendment -- it can bring close to target line breadth by things

[0035] On the other hand, in the batch number 10, the characteristic difference that wiring width-of-face change of the 3rd managed pattern 16 is larger than wiring width-of-face change of the 4th managed pattern 18 has occurred. In the 4th managed pattern 18, as explanation of a batch number 6 explained the amount of wiring width-of-face change from target line breadth, aligner sensitivity is the cause. However, in the batch number 10, the wiring width of face of the 3rd managed pattern 16 is further changed from the wiring width of face of the 4th circuit pattern by change of a focus. For this reason, there is amendment need about a focus with an amendment in the sensitivity as one of the exposure conditions of an aligner. That is, the error of the wiring width of face of the circuit pattern when imprinting an exposure pattern to Wafer WH in an aligner is based on change of sensitivity and or a focus. That is, you have to expose by rectifying these both.

[0036] Drawing 9 is a flow chart which shows the manufacture method of the semiconductor device as a desirable operation gestalt of this invention. The exposure pattern which has the managed pattern 1 which reaches 3rd managed pattern 16 and contains the 4th managed pattern 18 through layout design as mentioned above is created. This exposure pattern is imprinted by the aligner on Wafer WH (step ST 1). The wiring width of face of the 4th managed pattern 18 is measured as an exposed example (step ST 2).

[0037] It judges whether the wiring width of face of the measured 4th managed pattern 18 is within the limits from USL of drawing 8 to LSL (step ST 3), and if it is within the limits, the wiring width of face of the 3rd managed pattern 16 will be measured (step ST 11). It reaches 4th managed pattern 18 and a focal gap is judged with the wiring width of face of the 3rd managed pattern 16 (step ST 12). If there is no focal gap, it will end (step ST 14), and if there is a focal gap, focal gap **F will be computed (step ST 13). And based on focal gap **F, it amends based on the focal pair wiring width-of-face property table which stores the information on wiring width of face as opposed to a focus for the focus as exposure conditions for an aligner and which was prepared beforehand (step ST 10).

[0038] If there is no wiring width of face of the measured 4th managed pattern 18 within the limits of USL and LSL of drawing 8 on the other hand and the sensitivity gap has arisen (step ST 3), amount of exposure amendments **E of the exposure conditions of an aligner will be computed (step ST 4). Next, the wiring width of face of the 3rd managed pattern 16 is measured (step ST 5). It reaches 4th managed pattern 18 and a focal gap is judged with the wiring width of face of the 3rd managed pattern 16 (step ST 6).

[0039] If there is no focal gap, it will rectify based on the sensitivity pair wiring width-of-face property table which stores the information on wiring width of face over the sensitivity beforehand prepared in amount of exposure amendments **E, and if there are (Step ST9) and a focal gap, focal gap **F will be computed (step ST 7). Based on amount of exposure amendments **E, the light exposure as exposure conditions is rectified based on a focal pair wiring width-of-face property and the focus as exposure conditions is amended based on a sensitivity pair wiring width-of-face property based on focal gap **F (step ST 8).

[0040] Thus, exposure conditions are rectified and exposed in an aligner. As for Wafer WH, IC is manufactured through development etching process, an impurity diffusion process, a vacuum evaporationo process, and assembly and an inspection process.

[0041] As mentioned above, the circuit pattern exposed by the explained exposure method has an effect as taken below. Hereafter, the effect of the exposure method as a desirable operation gestalt of this invention etc. is explained using drawing 9 - drawing 11 . The following explanation explains using drawing showing a focal pair wiring width-of-face property, respectively like drawing 10 (A), drawing 10 (B), drawing 11 (A), and drawing 11 (B) as a representative.

[0042] In drawing 10 (A), drawing 10 (B), drawing 11 (A), and drawing 11 (B), a horizontal axis shows a focus and a vertical axis shows wiring width of face (line breadth), respectively. By this exposure method, a focus shall be fixed only to one certain point and exposure shall be performed. Moreover, the dotted line 22 prolonged in the direction of a vertical axis shows the focus beforehand set up in the aligner, and are the focal conditions at the time of actual exposure

[0043] It is the line breadth result and homonymy of one arbitrary lots which the portion shown by O in drawing 11 is exposed on the exposure conditions as actual light exposure and a focus, and the value of the intercept of O and a dotted line 22 is finished, serve as wiring width of face (size), and are shown by drawing 8 . Here, when the light exposure of this exposure method is changed, change appears [the wiring width-of-face properties 24 and 26] according to the property same with being shown in drawing 3 (C) and drawing 4 (C).

[0044] When only sensitivity change occurs, drawing 10 (A) shows the focal pair wiring width-of-face property when only sensitivity change occurs. Drawing 10 (B) shows the focal pair wiring width-of-face property about the result after an amendment of exposure conditions when only sensitivity change occurs.

[0045] When sensitivity is changed, it has rectified by the same method as the conventional exposure conditions. In drawing 10 (A), if the difference occurred in the result (place shown by O) of target line breadth and the actually exposed wiring width of face, it is over the line breadth specification lower limit to it and correction value **E by light exposure is rectified, the property k and the **** pattern property j of a dense pattern change upward so that it may be shown like drawing 10 (B), and it can drive into target line breadth

[0046] When sensitivity change and a focal change of a result by which drawing 11 (A) was exposed when sensitivity change and a focal change occurred occur, the focal pair wiring width-of-face property of an about is shown. Drawing 11 (B) shows the focal pair wiring width-of-face property about the result after an amendment of exposure conditions when sensitivity change and a focal change of a result which were exposed occur.

[0047] Drawing 11 (A) shows the focal pair wiring width-of-face property about the wiring width-of-face property of a circuit pattern when sensitivity change and a focal change of a result which were exposed occur. Drawing 11 (B) shows the focal pair wiring width-of-face property about the result after an amendment by amount of amendments **F of a focus, and amount of amendments **E of light exposure, when sensitivity change and a focal change of a result which were exposed occur.

[0048] Since amount of amendments **F of a focus like drawing 11 (A) and amount of amendments **E of light exposure are detected separately and it rectifies, respectively, a **** exposure pattern and a dense exposure pattern can drive the wiring width of face of a circuit pattern into target line breadth. Moreover, it can be made to be able to change to the field stabilized more, and the stability of the wiring width of face of the exposed circuit pattern can be raised because the wiring width-of-face property of a circuit pattern rectifies also to change of the bad focus conventionally.

[0049] When a focus and sensitivity are changed without according to the operation gestalt of this invention computing the optimal amount of amendments for exposing so that it may become a size aiming at the wiring width of face of the circuit pattern of IC in advance when an exposure pattern is exposed to Wafer WH, this amount of change can be detected separately. Moreover, these detection results can rectify exposure conditions separately.

[0050] By the way, this invention is not limited to the operation gestalt mentioned above. By the exposure method mentioned above, although two managed patterns are used, you may use three or more managed patterns. In the flow chart of drawing 9, although light exposure is previously detected when a focus and each light exposure are changed, even if it detects a focus previously, it can rectify similarly. Moreover, the manufacture method of the semiconductor device as a desirable operation gestalt of this invention is applicable also to things other than the manufacture method of a semiconductor device which imprints the beforehand regular exposure pattern to an object.

[0051]

[Effect of the Invention] Without computing the optimal amount of amendments for exposing in advance according to this invention so that it may become a size aiming at the wiring width of face of the circuit pattern of a semiconductor device as explained above The circuit pattern of target wiring width of face is exposed by things. each change of a focal position and sensitivity -- separation detection -- carrying out -- exposure conditions -- an amendment -- The circuit pattern from which the inclination of a focal position and sensitivity is furthermore managed with a sufficient precision, and the degree of high density of a circuit pattern differs can be exposed with a sufficient precision, and the productive efficiency of a semiconductor device can be improved.

[Translation done.]

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-133569
(43)Date of publication of application : 12.05.2000

(51)Int.Cl. H01L 21/027
G03F 7/207

(21)Application number : 10-303690
(22)Date of filing : 26.10.1998
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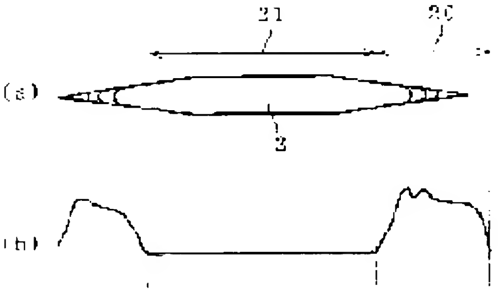
(54) METHOD FOR CORRECTING FOCUSING AND MANUFACTURE OF SEMICONDUCTOR DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To directly obtain the level and direction of the deviation in focus from a mark for measuring focus.

SOLUTION: A level of deviation in focus is measured from the length in the longitudinal direction of a mark 3 for measuring focus. The length of a taper part 20 of the mark 3 for focus measurement, at which the thickness of resist is made gradually thin is measured from the secondary electronic signal waveform of a scanning type electronic microscope. Then, the direction of the deviation of focus is found from the measured length of the taper part 20.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

[Claim(s)]

[Claim 1] The amendment method of a focus [in / the aligner which can adjust the position of a focus by setup of a focal value] characterized by providing the following. The patterning process which makes the mark for focal measurement to the resist concerned, and forms the aforementioned resist pattern in it in case patterning of the resist is carried out by exposure of the aforementioned aligner. The 1st measurement process which measures the length of the longitudinal direction of the aforementioned mark for focal measurement. The 2nd measurement process which measures the length of the taper section which becomes thin as the thickness of the aforementioned resist of the aforementioned mark for focal measurement goes to the edge of the mark for focal measurement concerned. The focal value setting process of determining the sense of the gap from the aforementioned base focus from the result of the measurement process of the above 2nd, calculating the amount of gaps from a best focus while determining the grade of the gap from [from the measurement result of the measurement process of the above 1st] a best focus, and setting up the aforementioned focal value based on the amount of gaps from the best focus concerned.

[Claim 2] The amendment method of a focus according to claim 1 further equipped with the data-accumulation process which accumulates the data about the amount of gaps from the aforementioned best focus, and the focal value setting process of computing the anticipation focus value which serves as a best focus at the time of exposure by processing the aforementioned data statistically, and setting up a focal value based on the anticipation focus value concerned whenever it repeats the aforementioned focal value setting process about the product of two or more sets of same forms.

[Claim 3] The aforementioned data accumulation process defines the sum of the aforementioned focal value and the amount of gaps from the aforementioned best focus as a true amount of gaps. The process which accumulates the true amount of gaps concerning two or more sets of products as data is included. the aforementioned focal value setting process The amendment method of a focus according to claim 2 which extracts the true amount of gaps concerning the product of the number of predetermined groups out of the data accumulated at the aforementioned data accumulation process, and is characterized by making the average of the true amount of gaps concerning the product of the predetermined group concerned into the aforementioned anticipation focus value.

[Claim 4] The aforementioned focal value setting process computes the true amount of gaps concerning the product of the number of predetermined groups from from among the accumulated aforementioned data. The amendment method of a focus according to claim 2 which applies the value proportional to the difference of the true amount of gaps about at least 2 sets of products manufactured just before or after the average of the true amount of gaps concerning the product of the number of predetermined groups concerned in two or more aforementioned sets of products, and is characterized

by making the sum into the aforementioned anticipation focus value.
[Claim 5] The amendment method of a focus given in any 1 term of a claim 1 to the claims 4 which compute the inclination of the aforementioned shot based on the amount of gaps from the best focus value of the aforementioned resist pattern in each point which arranges two or more aforementioned marks for focal measurement to one shot, and by which the aforementioned mark for focal measurement is arranged, and are characterized by to ask for the aforementioned anticipation focus **** in consideration of the inclination concerned.
[Claim 6] The amendment method of a focus given in any 1 term of a claim 1 to the claims 4 which arrange the aforementioned mark for focal measurement to the periphery and core of one shot, and are characterized by computing the aforementioned anticipation focus value based on the value between the true amount of gaps of the best focus in the periphery of the aforementioned shot, and the amount of gaps from the best focus value in a core.
[Claim 7] the weight [amount / of the best focus which arranges the aforementioned mark for focal measurement to two or more / in one shot /, and is measured by two or more aforementioned places / true / of gaps] according to the pattern layout in the aforementioned shot, or arrangement -- the price -- the amendment method of a focus given in any 1 term of a claim 1 to the claims 4 characterized by computing the aforementioned anticipation focus value by carrying out ******** processing
[Claim 8] The amendment method of a focus given in any 1 term of a claim 1 to the claims 7 which arrange the aforementioned mark for focal measurement or more to at least one in one shot, and are characterized by to calculate the amount of remains curvatures of the aforementioned wafer, to consider the amount of remains curvatures concerned, and to calculate the aforementioned anticipation focus value from the amount of gaps of the aforementioned mark for focal measurement formed in several places in a wafer by two or more exposure.
[Claim 9] The aforementioned mark for focal measurement is the amendment method of a focus given in any 1 term of a claim 1 to the claims 8 characterized by being a polygon with at least one or more angles of 90 or less degrees.
[Claim 10] The manufacture method of the semiconductor device characterized by manufacturing a semiconductor device using the aligner by which a focal amendment is carried out using the amendment method of one focus of a claim 1 to the claims 9.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the manufacture method of the semiconductor device using the aligner by which a focal amendment is carried out using the amendment method of the focus in an aligner (stepper), and the amendment method of the focus.
[0002]
[Description of the Prior Art] Conventionally the management about the focus of an aligner The focal calibration performed about several times on the 1st (management which measures the distance between a stage and a reticle and feeds back the amount of change to the focus at the time of exposure), The check of the best focus by resist pattern printing using the checking reticle performed about several times in January (by resist pattern printing) The management which computes the amount of gaps from the best focus of the present focus value by viewing or size measurement of a checking pattern etc., and is fed back to an aligner, It consisted of a check (management which measures the inclination of the field of a wafer, and the image surface of the shot of an aligner, unites, and is crowded) of a leveling function. These managements require time, cannot be followed from the ability of frequency not to be raised to periodic change of the focus of an aligner which has a period shorter than several hours, and have led to increase of change of the resist pattern by defocusing.
[0003] That to which that to which what adjusts a focus based on the amendment data obtained from the mark of the level difference formed in the wafer as a conventional aligner adjusts a focus to JP,9-92606,A using the checking pattern printed on the checking substrate makes it focal information with weight, and adjusts a focus to JP,5-190419,A in order to compensate phase lag of a focal signal is indicated by JP,7-86135,A.
[0004]
[Problem(s) to be Solved by the Invention] Since the amendment method of the conventional focus is performed as mentioned above, measurement of the amount of gaps of a focus is difficult for it, and it has the problem manufactured a short period that the amount of gaps of a focus can be measured for every lot, the measurement result of the amount of gaps cannot be efficiently employed in the following lot, and precision of a focal amendment cannot be raised.
[0005] This invention is made in order to cancel the above-mentioned trouble, and it aims at simplifying measurement of defocusing and enabling the focal amendment for every lot.
[0006]
[Means for Solving the Problem] In the amendment method of a focus [in / the aligner which can adjust the position of a focus / by setup of a focal value / in the amendment method of the focus concerning the 1st invention] The patterning process which makes the mark for focal measurement to the resist concerned, and forms the aforementioned resist pattern in it in case patterning of the resist is carried out by exposure of the aforementioned aligner, The 1st measurement process which measures

the length of the longitudinal direction of the aforementioned mark for focal measurement. The 2nd measurement process which measures the length of the taper section which becomes thin as the thickness of the aforementioned resist of the aforementioned mark for focal measurement goes to the edge of the mark for focal measurement concerned. While determining the grade of the gap from [from the measurement result of the measurement process of the above 1st] a best focus, determine the sense of the gap from the aforementioned base focus from the result of the measurement process of the above 2nd, and the amount of gaps from a best focus is calculated. It has the focal value setting process of setting up the aforementioned focal value based on the amount of gaps from the best focus concerned, and is constituted.

[0007] The amendment method of the focus concerning the 2nd invention is set to the amendment method of the focus the 1st invention. The data accumulation process which accumulates the data about the amount of gaps from the aforementioned best focus whenever it repeats the aforementioned focal value setting process about the product of two or more sets of same forms. By processing the aforementioned data statistically, the anticipation focus value which serves as a best focus at the time of exposure is computed, and it has further the focal value setting process of setting up a focal value based on the anticipation focus value concerned, and is constituted.

[0008] The amendment method of the focus concerning the 3rd invention is set to the amendment method of the focus the 2nd invention. the aforementioned data accumulation process The sum of the aforementioned focal value and the amount of gaps from the aforementioned best focus is defined as a true amount of gaps. The process which accumulates the true amount of gaps concerning two or more sets of products as data is included. the aforementioned focal value setting process The true amount of gaps concerning the product of the number of predetermined groups is extracted out of the data accumulated at the aforementioned data accumulation process, and it is characterized by making the average of the true amount of gaps concerning the product of the predetermined group concerned into the aforementioned anticipation focus value.

[0009] The amendment method of the focus concerning the 4th invention is set to the amendment method of the focus the 2nd invention. the aforementioned focal value setting process The true amount of gaps concerning the product of the number of predetermined groups is computed from from among the accumulated aforementioned data. The value proportional to the difference of the true amount of gaps about at least 2 sets of products manufactured just before or after the average of the true amount of gaps concerning the product of the number of predetermined groups concerned in two or more aforementioned sets of products is applied, and it is characterized by making the sum into the aforementioned anticipation focus value.

[0010] The amendment method of the focus concerning the 5th invention is set from the 1st to either of the amendment methods of the focus the 5th invention. The inclination of the aforementioned shot is computed based on the amount of gaps from the best focus value of the aforementioned resist pattern in each point which arranges two or more aforementioned marks for focal measurement to one shot and by which the aforementioned mark for focal measurement is arranged. It is characterized by asking for the aforementioned anticipation focus **** in consideration of the inclination concerned.

[0011] The amendment method of the focus concerning the 6th invention is characterized by to compute the aforementioned anticipation focus value in either of the amendment methods of the focus the 4th invention based on the value which arranges the aforementioned mark for focal measurement to the periphery and the core of one shot, and is between the true amount of gaps of the best focus in the periphery of the aforementioned shot, and the amount of gaps from the best focus value in a core from the 1st.

[0012] the weight [amount / of the best focus which the amendment method of the focus concerning the 7th invention arranges the aforementioned mark for focal measurement from the 1st to two or more / in one shot / in either of the amendment methods of the focus the 4th invention, and is measured by two or more aforementioned places true of gaps] according to the pattern layout in the aforementioned shot, or arrangement -- the price -- it is characterized by to compute the aforementioned anticipation focus value by carrying out ******** processing

[0013] The amendment method of the focus concerning invention of the octavus is set from the 1st to either of the amendment methods of the focus the 7th invention. The aforementioned mark for focal measurement is arranged or more to at least one in one shot. It is characterized by calculating the amount of remains curvatures of the aforementioned wafer, considering the amount of remains curvatures concerned, and calculating the aforementioned anticipation focus value from the amount of gaps of the aforementioned mark for focal measurement formed in several places in a wafer by two or more exposure.

[0014] The aforementioned mark for focal measurement is characterized by being the polygon in which the amendment method of the focus concerning the 9th invention has at least one or more angles of 90 or less degrees in either of the amendment methods of the focus invention of the 1st to the octavus.

[0015] The manufacture method of the semiconductor device concerning the 10th invention is characterized by manufacturing a semiconductor device using the aligner by which a focal amendment is carried out from the 1st using the amendment method of one focus of the 9th invention.

[0016]

[Embodiments of the Invention] The amendment method of the focus by the gestalt 1 of operation is explained using drawing 32 from drawing 1 below gestalt 1. of operation. Drawing 1 is the conceptual diagram showing the relation of the field (only henceforth a shot) and the mark for focal measurement by which the shot was carried out to the wafer. In drawing 1 , two or more shots 2 are arranged by exposure of multiple times to one wafer 1. Since at least one mark 3 for focal measurement is formed to one shot 2, although two or more marks 3 for focal measurement are formed in a wafer 1, in drawing 1 , a part of illustration of the mark 3 for focal measurement is omitted. The mark 3 for focal measurement is formed using the reticle on which the figure 100 which carried out the flat-surface configuration as shown in drawing 2 is drawn. If it is disregarded that the nose of cam of angle 4 can be deleted, it can be considered that the figure 100 of drawing 2 is the hexagon which has the angle with angle 4 smaller than 90 degrees. The length of the longitudinal direction of this figure 100 is 10 micrometers, and full is 0.5 micrometers. It has a portion with a width of face of 0.5 micrometers in right and left up to the place of 1 micrometer of right and left from the center position O of the longitudinal direction of the long mark 3 for focal measurement. The mark 3 for focal measurement is thin linearly, and the width of face at a nose of cam has become 0.1 micrometers as it goes to an edge exceeding 1 micrometer of right and left from Center O.

[0017] The resist film applied on the wafer 1 is repeated and exposed by the predetermined pattern which arranges the shot 2 including the mark 3 for focal measurement by the aligner (stepper). Patterning is completed by removing the portion which is not **(ed) by the portion **(ed) by light or light from this resist film. In the case of exposure, when the focus of an aligner shifts from the right best focus, the configurations of a predetermined pattern also including the mark 3 for focal measurement change.

[0018] Drawing 3 - drawing 11 are drawings showing the picture which observes the mark 3 for focal measurement with a scanning electron microscope, and is acquired. Drawing 3 - drawing 11 show the state where the mark 3 for focal measurement by which changed the state of a focus, respectively and patterning was carried out was observed by one 10000 times the scale factor of this from across. These marks 3 for focal measurement put in order in parallel four configurations shown in drawing 2 , and are constituted. Drawing 3 shows the mark 3 for focal measurement in a best focus state. As for drawing 4 to drawing 7 , only -0.4, -0.8, -1.2, and -1.6 (micrometer) show the mark 3 for focal measurement formed after the focus had shifted from the best focus, respectively. on the other hand -- drawing 8 - drawing 11 -- respectively -- 0.4 from a best focus, 0.8, and 1. -- the mark 3 for focal measurement in which only 2 and 1.6 (micrometer) were formed after the focus had shifted is shown Moreover, drawing 12 - drawing 20 are also drawings showing the picture which observes the mark 3 for focal measurement of four with a scanning electron microscope, and is acquired. However, drawing 12 - drawing 20 show the state where the mark 3 for focal measurement by which changed the state of a focus, respectively and patterning was carried out was observed by one 7500 times the scale factor of this from right above. Drawing 12 shows the mark 3 for focal measurement in a best focus state. As for drawing 13 to drawing 16 , only -0.4, -0.8, -1.2, and -1.6 (micrometer) show the mark 3 for focal measurement formed after the focus had shifted from the best focus, respectively. on the other hand -- drawing 17 - drawing 20 -- respectively -- 0.4 from a best focus, 0.8, and 1. -- the mark 3 for focal measurement in which only 2 and 1.6 (micrometer) were formed after the focus had shifted is shown

[0019] Drawing 3 - drawing 20 show that the length of the longitudinal direction of the mark 3 for focal measurement tends to become short as the amount of gaps from a best focus becomes large. When the reticle by which the mark 3 for focal measurement shown in drawing 2 is drawn is used, the length of a longitudinal direction is set to about 8 micrometers in the state of a best focus. However, the length of a longitudinal direction becomes short about 1.5 micrometers by 1-micrometer defocusing. Thus, the relation between the length of the longitudinal direction of the mark for focal measurement and defocusing is investigated, and the graph which indicated a characteristic curve applicable to two or more sets of products which can be regarded as stepper processing having accomplished on the same conditions beforehand like drawing 21 is created and prepared. For example, the grade of defocusing can be judged by measuring the length of the longitudinal direction of the mark 3 for focal measurement by which patterning was carried out using a scanning electron microscope (henceforth SEM). Drawing 22 is the conceptual diagram showing the composition of SEM. SEM10 emitted the electron and is equipped with the electron gun 11 which converges in the shape of a beam. A condensing lens 14 extracts thinly the electron beam which came out of this electron gun 11, and after that, a deflecting coil 15 deflects an electron beam so that the scanning electron beam 16 may scan a wafer 1 top. Although a secondary electron will be emitted from the front face of a wafer 1 if the scanning electron beam 16 hits the front face of a wafer 1, SEM10 catches this secondary electron with the secondary electron detector 17, changes the amount of a secondary electron into the luminosity of the scanning line of the Braun tube 18, and projects the irregularity of the front face of a wafer 1. An image as shown in drawing 3 - drawing 20 is observable with such SEM10.

[0020] By the way, although the grade of defocusing can be distinguished when the length of the longitudinal direction of the mark 3 for focal measurement is measured, judgment of whether to have shifted in the negative direction whether it has shifted in the right direction cannot be performed. Then, the length of the taper section 20 as shown in drawing 12 in order to judge whether it has shifted in which direction of positive/negative from the image observed by SEM10 for example, is measured. Drawing 23 is drawing for explaining the relation between a SEM picture and secondary electron signal wave type. By the SEM picture of drawing 23 (a), the taper section 20 and a flat part 21 can be distinguished. For example, in the SEM picture of drawing 23 (a), dispersion of a secondary electron becomes large in the taper section 20 which becomes thin as the thickness of the resist of the mark 3 for focal measurement goes to the edge of the mark 3 for focal measurement. Therefore, from the secondary electron signal wave type (refer to drawing 23 (b)), the taper section 20 and a flat part 21 can be distinguished clearly, and the length of the taper section 20 can be measured. Drawing 24 is a graph which shows the relation between the length of the taper section, and the gap from a base focus. The graph of drawing 24 summarizes the inclination of change of the length of the taper section 20 shown in drawing 11 from drawing 3 about the case where a negative type resist is used. or [that the length of the taper section 20 hardly changes when the focus has shifted in the negative direction] -- or there is an inclination which decreases for a while On the other hand, when the focus has shifted in the right direction, the length of the taper section 20 becomes long as the grade of defocusing becomes large. The direction of defocusing can be distinguished by such difference. In addition, when the amount of gaps is negative, the length of the taper section 20 increases the relation between the length of the taper section 20 in the case of using a positive type resist, and the amount of gaps from a best focus.

[0021] The judgment procedure of the amount of gaps from the above best focus can be packed into a flow chart like drawing 25 . First, patterning of the resist is carried out using the reticle by which the mark for focal measurement is arranged. The length of the longitudinal direction of the mark 3 for focal measurement by which patterning was carried out is measured by SEM10 (step ST 1). From the measurement result of a step ST 1, it shifts using the relation between the amount of gaps of a focus, and the length of the longitudinal direction of the mark 3 for focal measurement, and an amount is determined (step ST 2). Next, the length of the taper section 20 of the mark 3 for focal measurement is measured by SEM10 (step ST 3). The direction of defocusing is determined from the measurement result of a step ST 3 (step ST 4). Thus, if drawing corresponding to the mark 3 for focal measurement is drawn to the reticle, since it is in the middle of manufacture, a product is extracted and the amount of gaps of a focus can be judged, based on the amount of gaps of the focus of the lot, a focal value can be set up to the lot manufactured by the degree of the lot.

[0022] Next, the production system which manufactures a semiconductor device is explained, processing statistically the data about the amount of gaps of the focus of the past lot. Drawing 26 is the block diagram showing an example of a production system. The main part 31 of a production control system which performs manufacture management of a semiconductor device is in a production system, and the semiconductor fabrication machines and equipment 32 of a stepper 34, SEM10, or others are connected to this main part 31 of a production control system through the terminal 33 for reference. The stepper 34 and semiconductor fabrication machines and equipment 32 which are connected to this main part 31 of a production control system, and SEM10 may be plural, respectively. There are a sputtering system, an etching system, etc. in semiconductor fabrication machines and equipment 32. In a production control system 10, two or more semiconductor integrated circuits are formed on a wafer 1 using the semiconductor fabrication machines and equipment 32 of a stepper 34 or others. To an erector degree etc., a semiconductor device attaches a leadframe, a lead, a package, etc. in this semiconductor integrated circuit, and is formed in it. The main part 31 of a production control system manages the data about a focus obtained from this stepper 34, SEM10, etc. The amount of gaps of a focus is contained in the data about a focus, and the data about a focus are stored in database 31b of the main part 31 of a production control system. Focal amendment section 31a of the main part 31 of a production control system calculates the anticipation focus value for rectifying a focus using the data stored in database 31b.

[0023] The data of data number i=1-4 as shown in drawing 27 are kept by database 31b of the main part 31 of a production control system. These data show that it is the past data, so that a data number is small, set the data (henceforth the newest data) of the past near this time to i= 1, and enumerate them in order. For example, focal amendment section 31a calculates the average of the data of data number i=1-4, and the focal value Pr 1 of a stepper 34 is set up based on the average acquired by performing statistical processing. that is. S0 and each focal value were measured by Si and SEM10 in the anticipation focus value -- if it shifts and an amount is expressed with " (-Ki) -- an anticipation focus value -- S0=sigma(Si-Ki) n .... (formula 1) -- it is come out and given Here. total (sigma) is given with the value to which the value in () totaled all the values at the time of i= 1 to i=n. The procedure of this calculation sorts out the data about the focus used for the calculation first as collected into the flow chart of drawing 28 (step ST 11). Since products differ or some which become old too much are also in the data about a focus. only what is used for calculation is sorted out in accordance with predetermined criteria. Here. four new data including the newest data are extracted. That is. in the case of this example. the data of four newest lots as the predetermined number of groups are extracted. These data are products it is considered that are those by which stepper processing was made on the same conditions. if it puts in another way. these data should pass the same history (the process which forms the film of the same thickness by the film of the same kind. and process which adds the same heat history) -- it is the formed product Next. the true amount of gaps of a focal value is calculated (step ST 12). Since the amount of gaps (-Ki) measured by SEM10 is the amount of gaps from the focal value set up last time. a gap is small shown only for the part of the focal value set up last time to the true amount of gaps. Then. it is necessary to compute the true amount (Si-Ki) of gaps by rectifying the focal value set up last time about the amount of gaps measured by SEM10. Next. the average of the true amount of gaps is calculated by only the predetermined number of times (for example. 4 times) going back in front from the newest data (step ST 13). Thus. the calculated value turns into a focal value (henceforth an anticipation focus value) used for next exposure.

[0024] An anticipation focus value can also consider and ask for change between new data. For example. using data i=1-4 shown by drawing 27 . as shown in drawing 29 . the anticipation focus value Pr 2 can be set up. That is. the value VA 2 which doubled the difference VA 1 of the true amount of gaps which the newest data i= 1 and the data i= 2 in front of it show q is added to the average of data i=1-4. and the anticipation focus value Pr 2 is determined. Generally. the anticipation focus value S0 is. S0=sigma(Si-Ki)/n+qx {(S1-K1)- (S2-K2)} .... (formula 2)

It is come out and given. Hereafter. an average term and the term of qx {(S1-K1)- (S2-K2)} are called change term for this term of sigma (Si-Ki)/n shown in a formula 2. n of a formula 1 and a formula 2 and q are constants suitably set up for every statistical calculation. For example. as for n. carrying out to three or more is desirable. and. as for q. it is desirable to set it as the value to which dispersion in the amount of gaps from a best focus becomes the smallest. The desirable constants n and q can be experientially drawn, while repeating statistical calculation. Thus. by calculating an anticipation focus value reflecting a change term. it can bring close to the true amount of gaps with the expected true actual amount of gaps. and the accuracy of a focal amendment can be improved compared with the case of a formula 1. In addition. generally a change term is sigmaqjx[(Sj-Kj)-{(S(j+1)-K(j+1)} it can express] and not only processing and processing before last of the last time of the processing but the processing before second from last time may be made to reflect in calculation). In that case. you may set up the value of a constant qj individually. You may not be the last data although it is desirable to use the last data when using the difference of the true amount of gaps. The calculation procedure of an anticipation focus value is explained using the flow chart of drawing 30 . First. the average of the true amount of gaps as well as the case where the average is used as an anticipation focus value is calculated by extracting the data (data about the true amount of gaps) about the focal value of the suitable past from database 31b (Steps ST11-ST13). Furthermore. a change term is calculated using the data extracted from database 31b (step ST 14). The change term taken out with a step ST 14 is added to the average computed at a step ST 13. and the anticipation focus value S0 is calculated (step ST 15). The true amount of gaps is computed from the amount of gaps from the best focus for which it asked from measurement by SEM10 etc. (-Ki), the value is substituted for a formula, and comparison of the case where the anticipation focus value S0 of a next lot is calculated, and the case (when a focal value is fixed) where a setup of a focal value is not carried out is shown in drawing 31 . By using the anticipation focus value S0 calculated using the formula 2, the average of the amount of gaps from a best focus approaches 0, change is small and a bird clapper is known.

[0025] Gestalt 2. drawing 32 of operation is the plan showing the relation of the shot and the mark for focal measurement in the amendment method of the focus of the gestalt 2 operation. As shown in drawing 32 , the marks 3a-3d for focal measurement are arranged in the four corners of a shot 2. Fixed distance Dy (micrometer) is all among the marks 3b and 3d for focal measurement between the marks 3a and 3c for focal measurement, and there is all fixed distance Dx (micrometer) among the marks 3c and 3d for focal measurement between the marks 3a and 3b for focal measurement. Moreover, the same y-coordinate up has mutually the marks 3a and 3b for focal measurement, and the marks 3c and 3d for focal measurement are also on the same y-coordinate as each other. The same x-coordinate up has mutually the marks 3a and 3c for focal measurement, and the marks 3b and 3d for focal measurement are on the same X coordinate as each other. X component of the inclination of a shot 2 is defined by how much the straight line which connects the middle point of the marks 3a and 3c for focal measurement and the marks [for focal measurement / 3b and 3d] middle point leans to the straight line passing through the middle point which are the marks 3b and 3d for focal measurement parallel to the X-axis. That is, the X component Ex of an inclination is, when the true amount of gaps of a marks [for focal measurement / 3a-3d] focus is made into Sa-Sd (micrometer). $Ex= \{(Sa+Sc)/2-(Sb+Sd)/2\}/Dx$ .... (formula 3)

It is come out and given. Similarly, Y component of the inclination of a shot 2 is defined by how much the straight line which connects the middle point of the marks 3a and 3b for focal measurement and the marks [for focal measurement / 3c and 3d] middle point leans to the straight line passing through the middle point which are the marks 3c and 3d for focal measurement parallel to a Y-axis. Namely, Y component Ey of an inclination $Ey= \{(Sa+Sb)/2-(Sc+Sd)/2\}/Dy$ .... (formula 4)

It is come out and given. The unit of these inclinations Ex and Ey is a radian.

[0026] An amendment of these inclinations Ex and Ey as well as the gestalt 1 of operation can be predicted. When the correction value of XY component of an inclination is expressed as Fxi and Fyi, the average is used for the anticipation inclination correction value Fx0 and Fy0, and it is $Fx0=\mathrm{sigma}(Fxi-Exi)/n$, respectively. .... (formula 5)

$Fy0=\mathrm{sigma}(Fyi-Eyi)/n$ .... (formula 6)

It is come out and given.

[0027] Moreover, the anticipation inclination correction value Fx0 and Fy0 seasons the average with a change term, and is each. $Fx0=\mathrm{sigma}(Fxi-Exi)/n +qxx \{(Fx1-Ex1)-(Fx2-Ex2)\}$ .... (formula 7)

$Fy0=\mathrm{sigma}(Fyi-Eyi)/n +qyx \{(Fy1-Ey1)-(Fy2-Ey2)\}$ .... (formula 8)

It is come out and given. This n, qx, and qy are a constant suitably set up for every statistical calculation. performing statistical calculation like a formula 7 and a formula 8 using the data of the lot of the past of the values Ex and Ey of this inclination component -- anticipation inclination correction value (Fx0, Fy0) -- computing -- this prediction inclination correction value Fx0 and Fy0 -- using -- the main part 31 of a production control system -- the inclination of the shot of a stepper 4 -- an amendment -- the precision of an inclination amendment can be raised by things Drawing 33 is a graph which shows change of Y component of an inclination for comparing the case where it does not carry out with the case where an inclination amendment of a shot is performed. From drawing 33 , as for by performing an inclination amendment, the average of an inclination approaches 0 and the width of face of change also shows that it is small. In addition, although the gestalt 2 of the above-mentioned implementation explained the case where the mark 3 for focal measurement was four, if there are at least three, the flat surface of a shot 2 is specified and an inclination component can be computed, respectively.

[0028] Gestalt 3. drawing 34 of operation is the plan showing the relation of the shot and the mark for focal measurement in the gestalt 3 of operation. Drawing 35 is the conceptual diagram of the curvature of field for explaining the outline of the focal amendment by the gestalt 3 of operation. In order to give explanation easy, in drawing 35 , the curve of a shot 2 is actually emphasized also for the twist. As for the image of a shot 2, a core draws the smooth surface of a convex. The edge of a shot 2 and a core change in the position to which an image is connected with curvatures of field which the lens of a stepper 4 has. Therefore, setup used as a best focus also differs. That is, even if it is in a best focus state by the marks 3a-3d for focal measurement, mark 3e for focal measurement of a core will separate only from the part of a curvature of field from a best focus. Then, the flat surface PL which intersects the straight line which connects mark 3e for focal measurement and the marks 3a-3d for focal measurement is assumed, and it sets up so that the amount of gaps from the best focus in the flat surface PL may become the minimum from the amount of gaps from the best focus in the edge of a shot 2, and the amount of gaps from the best focus in a core.

[0029] For example, if the amount of gaps of the mark 3a-3e truth for focal measurement is expressed as Sa-Se, it is the amount Sp of gaps of a flat surface PL. Sp= {Se- (Sa+Sb+Sc+Sd) 4} 2 .... (formula 9)

It is come out and given. Thus, by bringing close to a best focus in consideration of a curvature of field, the whole shot 2 can be brought close to the state of a best focus compared with the case where the edge or core of a shot 2 is made into a best focus state. In addition, although the imagination flat surface PL is arranged to 1/2 of the places of a gap of an edge and a core in the above-mentioned explanation, it does not restrict to the place of 1/2, and it may bring close to either an edge or a core, and you may arrange.

[0030] An amendment of this flat surface PL can also be predicted. When the amount of gaps of the flat surface PL calculated from the amount of gaps measured by Si and SEM10 in the focal value is expressed as (-Spi), the average is used for the anticipation focus value S0, and it is S0=sigma(Si-Spi)/n. .... (formula 10)

It is come out and given.

[0031] Moreover, the anticipation focus value S0 seasons the average with a change term. S0=sigma(Si-Spi)/n +qx {(S1-Sp1)- (S2-Sp2)} .... (formula 11)

It is come out and given. This n and q are a constant suitably set up for every statistical calculation. Using the data of the lot of the past of this amount Sp of gaps, by performing statistical calculation like a formula 10 and a formula 11, when the anticipation focus value S0 is predicted and the main part 31 of a production control system sets up a stepper 4 using this anticipation focus value S0, the precision of a focal amendment can be raised.

[0032] Also in the amendment method of the focus by the gestalt 4 of gestalt 4. implementation of operation, as shown, for example in drawing 36 , two or more marks 3-1 for focal measurement - 3-m are arranged in one shot 2. In drawing 36 , the illustration ellipsis of the mark 3-3 to 3-j-1 for focal measurement, and 3-j+1 - 3-m is carried out. The dimensional accuracies for which the field of the circumference where each mark 3-1 for focal measurement - 3-m are arranged is needed may differ, respectively. For example, as for the field Arj around mark 3-j for focal measurement, close dimensional accuracy is required rather than the field Arn around mark 3-n for focal measurement. In this case, if the true amount of gaps of mark 3-j for focal measurement and the true amount of gaps of mark 3-m for focal measurement are similarly treated, specification may not no longer be fulfilled in the field Arj of which close dimensional accuracy is demanded influenced by mark 3-n for focal measurement of a gap.

[0033] Then, it carries out with weight so that the amount of gaps of the mark for focal measurement of the place near the field of which close dimensional accuracy is required may be made to reflect in a setup of a focal value greatly and the amount of gaps of the mark for focal measurement of the place near the field of which a low dimensional accuracy is required conversely may not be made to reflect in a setup of a focal value not much.
[0034] If the amount of gaps of the focus obtained by giving weight (-H) makes the amount of gaps measured by SEM10 of the mark 3-1 for focal measurement - 3-m - (-G1) (-Gm)
H=(k1xG1+k2xG2+--+kmxGm) (k1+k2+--+km) .... (formula 12)
It is come out and given. In addition, coefficients k1-km can also be made into zero, respectively, and the same result as the mark for focal measurement not having been arranged is obtained in the field of which a low dimensional accuracy is required in that case.
[0035] An amendment of the amount of gaps of the focus obtained by giving this weight (-H) can also be predicted. When a focal value is expressed as Si, the average is used for the anticipation focus value S0, and it is S0=sigma(Si-Hi)/n. .... (formula 13)
It is come out and given.
[0036] Moreover, the anticipation focus value S0 seasons the average with a change term.
S0=sigma(Si-Hi)/n +qx {(S1-H1)- (S2-H2)} .... (formula 14)
It is come out and given. This n and q are a constant suitably set up for every statistical calculation. Using the data of the lot of the past of this amount Hi of gaps, by performing statistical calculation like a formula 13 and a formula 14, when the anticipation focus value S0 is predicted and the main part 31 of a production control system sets up a stepper 4 using this anticipation focus value S0, the precision of a focal amendment can be raised.
[0037] The amendment method of the focus by the gestalt 5 of gestalt 5. implementation of operation is the amendment which took the curvature of a wafer into consideration. As shown in drawing 37 , a difference is possible for the height of outermost periphery 1b of a wafer 1, and core 1a. In order to perform the amendment method of the focus by the gestalt 5 of operation in consideration of the difference in this height, it is necessary to classify the mark for focal measurement respectively formed on a wafer at the shot by which multiple-times irradiation is carried out according to the position on a wafer. For example, the shots 2a-2d of drawing 1 are shots currently irradiated by wafer 1 outermost periphery 1b, and the marks 3p-3s for focal measurement formed of the shots 2a-2d are classified into a set of the mark arranged at outermost periphery 1b. On the other hand, shot 2e of drawing 1 is a shot currently irradiated by core 1a of a wafer 1, and it is classified into a set of the mark arranged at core 1a mark 3t for focal measurement formed of the shot 2e. The amount J of remains curvatures of a wafer 1 is defined by the difference (J=W1-W2) of the amount W1 of gaps from the best focus of the shot of core 1a of a wafer 1, and the amount W2 of gaps from the best focus of the shot of outermost periphery 1b of a wafer 1. The amount of gaps of each shot to a best focus may be given in approximation in the amount of gaps of the mark for focal measurement in one shot, and may be given in approximation by the average of the amount of gaps of two or more marks for focal measurement. When the amount of gaps of a shot is represented with the amount of gaps of one mark for focal measurement, as for the position in the shot of the mark for focal measurement, unifying between shots is desirable. For example, it is given with the difference of the amount of gaps from a marks [for focal measurement / 3p-3s] best focus, and the amount of gaps from a mark 3t [for focal measurement] best focus. The amount of gaps from a marks [in outermost periphery 1b / for focal measurement / 3p-3s] best focus may be calculated from one mark for focal measurement, and may average and calculate the amount of gaps of two or more marks for focal measurement. Usually, since leveling of a wafer 1 is performed correctly, even if it uses one mark for focal measurement in outermost periphery 1b, the height of outermost periphery 1b can be represented almost surely.

[0038] The amount J of remains curvatures of a wafer 1 can be similarly predicted to be the amount S0 of gaps from the best focus in the gestalt 1 of operation. The average of the data Ji (i=1-n) of the past memorized by database 31b is used for the amount J0 of prediction remains curvatures, and it is
J0=sigmaJi/n. .... (formula 15)
It is come out and given. Or the amount J0 of prediction remains curvatures considers a change term.
J0=sigmaJi/n+qx (J1-J2) .... (formula 16)
It is come out and given. In addition, the past data Ji used for one statistical calculation must be what passed through the same history at least. For example, if the membranous kind and membranous thickness which are formed on a wafer 1 similarly have the same heat history that what is necessary is just a product of the same kind even if it is not a product of the same kind, it is possible to deal with it as what passed through the same history.

[0039] Formula of the focal value M of each shot in the wafer 1 in consideration of this amount J0 of prediction remains curvatures M=J0x(distance from center of wafer 1 of shot of distance / wafer outermost periphery from center of wafer 1 of each shot) xW1 .... (formula 17)
It is come out and given. If the focal value M calculated by this formula 17 is used as a focal value of each shot at the time of exposure, improvement in precision can be aimed at compared with the case where the amount of gaps of one shot 2 in a wafer 1 is used as a focal value of all the shots 2, and simplification of measurement and calculation can be attained compared with the case where repeat measurement and calculation every shots 2 of all in a wafer 1, and a focal value is calculated.

[0040] In addition, in statistical processing of the data explained with the gestalten 1-5 of operation, you may add processing which is explained below. Drawing 38 is a graph which shows the relation between the turn of the processed lot, and the true amount of gaps of the lot concerned. The data shown in the graph of drawing 38 are data sorted out through the same process as the step ST11 grade of drawing 28 . The true amount of gaps of a data number i+2 shown in drawing 38 is projected from the true amount of gaps of other data numbers. This is presumed to be what the error of the measurement in malfunction of a stepper 4 and superposition test equipment 5, an operator's failure, etc. produced owing to. If anticipation stepper correction value is computed using the true amount of gaps of this data number i+2 as it is, as a solid line shows to drawing 39 , data number i and the stepper set point of i+1 will become larger than the optimal stepper set point, and possibility that data number i and the data of i+1 will shift from a specification value following the data of a data number i+2 will become large. Thus, since the failure of the operator who is the cause by which a value shifts greatly etc. is transient and the value is large, the influence which it has on calculation of anticipation stepper correction value is large, and not being repeated with the following lot is a usual state. Therefore, when anticipation stepper correction value is calculated by considering such data, possibility that the precision of a focal amendment will get worse on the contrary is large, therefore possibility of separating from a specification value as a solid line shows to drawing 40 becomes large.

[0041] In the amendment method of the focus of the gestalten 1-5 operation unusual data like a data number i+1 shown in drawing 38 can be eliminated from calculation of anticipation stepper correction value. Drawing 41 is a flow chart which shows the procedure. Processing shown in drawing 41 is performed in case data are registered into database 31b. First, at a step ST 301, sorting of data is performed like the step ST 11 of drawing 28 . Next, at a step ST 302, the one newest data is extracted out of the data sorted out. The newest data are the newest in each group which is used for calculation of each anticipation stepper correction value and which was sorted out. At a step ST 302 The amount of filters − the true amount of gaps in front of amount of gaps - of the truth immediately after measurement of the amount of gaps by SEM The calculation -- (formula 18) is performed. Here, the last true amount of gaps is data extracted at a step ST 302. At a step ST 304, the comparison test of the amount of filters which calculated and obtained the formula 18 in a step ST 303, and the predetermined specification value is carried out. For example. in the case of the amount of specification value > filters. a judgment result is considered as success (O.K.). On the other hand. in the case of the amount of specification value < = filters. a judgment result is made into rejection (NG). When judged with a rejection. it progresses to a step ST 305. and it is the same as the true amount of gaps immediately after measurement of the amount of gaps by SEM. and the flag which shows judgment result rejection (NG) is inputted. That is. it is shown that the data about the true amount of gaps to which the flag was given are a judgment result rejection. The data to which such a flag was given are set up so that it may not sort out in the step ST 201 of drawing 28 . The filter ability which removes unusual data can be given by performing such a setup.

[0042] A dashed line shows the measurement result of the amount of gaps by the stepper set point and SEM at the time of applying such filter ability to drawing 39 and drawing 40 . Since the data of a data number i+2 are eliminated from the data used for calculation and are not reflected in anticipation stepper correction value by applying filter ability. the stepper set point does not become larger than required. but possibility that the measurement result of the amount of gaps by SEM will also be settled in a specification value becomes high. That is. that filter ability gives to the amendment method of a focus will improve and improve the precision of a focal amendment.

[0043] Drawing 42 is a timing chart which shows processing progress of Product A and Product B. An exposure limit is explained using drawing 42 . Product B shall be processed by the stepper 4 following Product A. In case the data of Product A and Product B are sorted out at the step ST 11 of drawing 28 at this time. it is data classified into the same group. When exposing Product B after the exposure processing end of Product A and it is. before measurement of the amount of gaps by SEM about Product A is completed (time t11). after measurement of the amount of gaps by the case where exposure is started. and SEM about Product A is completed. when it is (time t12). there are two kinds with the case where exposure is started of cases. An exposure limit is forbidding exposure processing of the product B before the measurement end of the amount of gaps by SEM (time t11) about Product A. and permitting exposure processing of the product B after the measurement end of the amount of gaps of Product A (time t12). If it does in this way. since the data concerning the focus of Product A cannot be used when possibility that the precision of a focal amendment will be improved becomes high and Product A becomes substandard. since the data concerning the newest focus were surely used in exposure processing of Product B. it can lessen that Product B becomes substandard.

[0044] Drawing 43 is a flow chart which shows the procedure of the exposure limit in the amendment method of a focus. A step ST 401 is a step which sorts out the data concerning a focus as well as a step ST 301. The one data newest at a step ST 402 is extracted following a step ST 401. This step ST 402 is the same as a step ST 302. However. the data extracted and used are the completion flag of the amount measurement processing of gaps by SEM given to the data concerning a focus. This completion flag of measurement processing is inputted in case it registers for example. with database 31b. At a step ST 403. the existence of this completion flag of measurement processing is judged. When the completion flag of measurement processing is not given. in order to forbid stepper processing of the product. the processing prohibition information that exposure processing prohibition disposal is directed is outputted.

[0045]

[Effect of the Invention] As explained above. the 1st and 2nd measurement processes can be carried out for every manufacture of a product. the amount of gaps from a best focus can measure easily for every product. a setup of a focal value can change a short period compared with the former. and. according to the amendment method of a focus according to claim 1. or the manufacture method of a semiconductor device according to claim 10. it is effective in the ability to be able to raise the precision of a focal amendment.

[0046] Since according to the amendment method of a focus according to claim 2 an anticipation focus value is computed from the data of the past about the amount of gaps from a best focus and a setup of a focal value is made based on this anticipation focus value, it is effective in the ability to raise the precision of a focal amendment compared with the case where a focal value is not predicted.
[0047] According to the amendment method of a focus according to claim 3, an anticipation focus value can be acquired easily and it is effective in the ability to raise the precision of a focal amendment simply.
[0048] Since the accuracy of prediction of an anticipation focus value improves by adding a change term to the average of the true amount of gaps according to the amendment method of a focus according to claim 4, it is effective in the accuracy of a focal amendment improving compared with the case where the average is used as an anticipation focus value.
[0049] According to the amendment method of a focus according to claim 5, the error by the inclination of a shot is corrected, an amendment of a focus can be performed, and it is effective in the ability to raise the precision of a focal amendment.
[0050] According to the amendment method of a focus according to claim 6, an amendment of a focus can be performed in consideration of the influence of the curvature of field in a shot, and it is effective in the ability to raise the precision of a focal amendment.
[0051] According to the amendment method of a focus according to claim 7, it is effective in the ability of the demand of improvement in the precision of a focal amendment to raise the precision of a high place preponderantly.
[0052] According to the amendment method of a focus according to claim 8, even if it measures the state of a focus about no shots to a wafer, it is effective in the ability to perform a focus reflecting the difference in the amount of remains curvatures of a wafer.
[0053] According to the amendment method of a focus according to claim 9, the taper section of the mark for focal measurement which shows the direction of a gap of a focus can be enlarged by using the angle of 90 or less degrees, and it is effective in measurement of the amount of gaps from a best focus becoming easy.

[Translation done.]

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TECHNICAL FIELD

[The technical field to which invention belongs] This invention relates to the manufacture method of the semiconductor device using the aligner by which a focal amendment is carried out using the amendment method of the focus in an aligner (stepper), and the amendment method of the focus.

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PRIOR ART

[Description of the Prior Art] The management about the focus of the former and an aligner is the focal calibration (management which measures the distance between a stage and a reticle and feeds back the amount of change to the focus at the time of exposure) performed about several times on the 1st, and the check (resist pattern printing.) of the best focus by resist pattern printing using the checking reticle performed about several times in January. The amount of gaps from the best focus of the present focus value by viewing or size measurement of a checking pattern etc. was computed, and it had become the management fed back to an aligner from the check (management which measures the inclination of the field of a wafer, and the image surface of the shot of an aligner, unites, and is crowded) of a leveling function. These managements require time, cannot be followed from the ability of frequency not to be raised to periodic change of the focus of an aligner which has a period shorter than several hours, and have led to increase of change of the resist pattern by defocusing.
[0003] In order that that to which what adjusts a focus based on the amendment data obtained from the mark of the level difference formed in the wafer as a conventional aligner adjusts a focus to JP,9-92606,A using the checking pattern printed on the checking substrate may compensate JP,5-190419,A for the phase lag of a focal signal. What makes it focal information with weight and adjusts a focus is indicated by JP,7-86135,A.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, the 1st and 2nd measurement processes can be carried out for every manufacture of a product, the amount of gaps from a best focus can measure easily for every product, a setup of a focal value can change a short period compared with the former, and, according to the amendment method of a focus according to claim 1, or the manufacture method of a semiconductor device according to claim 10, it is effective in the ability to be able to raise the precision of a focal amendment.

[0046] Since according to the amendment method of a focus according to claim 2 an anticipation focus value is computed from the data of the past about the amount of gaps from a best focus and a setup of a focal value is made based on this anticipation focus value, it is effective in the ability to raise the precision of a focal amendment compared with the case where a focal value is not predicted.

[0047] According to the amendment method of a focus according to claim 3, an anticipation focus value can be acquired easily and it is effective in the ability to raise the precision of a focal amendment simply.

[0048] Since the accuracy of prediction of an anticipation focus value improves by adding a change term to the average of the true amount of gaps according to the amendment method of a focus according to claim 4, it is effective in the accuracy of a focal amendment improving compared with the case where the average is used as an anticipation focus value.

[0049] According to the amendment method of a focus according to claim 5, the error by the inclination of a shot is corrected, an amendment of a focus can be performed, and it is effective in the ability to raise the precision of a focal amendment.

[0050] According to the amendment method of a focus according to claim 6, an amendment of a focus can be performed in consideration of the influence of the curvature of field in a shot, and it is effective in the ability to raise the precision of a focal amendment.

[0051] According to the amendment method of a focus according to claim 7, it is effective in the ability of the demand of improvement in the precision of a focal amendment to raise the precision of a high place preponderantly.

[0052] According to the amendment method of a focus according to claim 8, even if it measures the state of a focus about no shots to a wafer, it is effective in the ability to perform a focus reflecting the difference in the amount of remains curvatures of a wafer.

[0053] According to the amendment method of a focus according to claim 9, the taper section of the mark for focal measurement which shows the direction of a gap of a focus can be enlarged by using the angle of 90 or less degrees, and it is effective in measurement of the amount of gaps from a best focus becoming easy.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Since the amendment method of the conventional focus is performed as mentioned above, measurement of the amount of gaps of a focus is difficult for it, and it has the problem manufactured a short period that the amount of gaps of a focus can be measured for every lot, the measurement result of the amount of gaps cannot be efficiently employed in the following lot, and precision of a focal amendment cannot be raised.
[0005] This invention is made in order to cancel the above-mentioned trouble, and it aims at simplifying measurement of defocusing and enabling the focal amendment for every lot.

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MEANS

[Means for Solving the Problem] In the amendment method of a focus [in / the aligner which can adjust the position of a focus / by setup of a focal value / in the amendment method of the focus concerning the 1st invention] The patterning process which makes the mark for focal measurement to the resist concerned, and forms the aforementioned resist pattern in it in case patterning of the resist is carried out by exposure of the aforementioned aligner, The 1st measurement process which measures the length of the longitudinal direction of the aforementioned mark for focal measurement, The 2nd measurement process which measures the length of the taper section which becomes thin as the thickness of the aforementioned resist of the aforementioned mark for focal measurement goes to the edge of the mark for focal measurement concerned, While determining the grade of the gap from [from the measurement result of the measurement process of the above 1st] a best focus, determine the sense of the gap from the aforementioned base focus from the result of the measurement process of the above 2nd, and the amount of gaps from a best focus is calculated. It has the focal value setting process of setting up the aforementioned focal value based on the amount of gaps from the best focus concerned, and is constituted.
[0007] The amendment method of the focus concerning the 2nd invention is set to the amendment method of the focus the 1st invention. The data accumulation process which accumulates the data about the amount of gaps from the aforementioned best focus whenever it repeats the aforementioned focal value setting process about the product of two or more sets of same forms, By processing the aforementioned data statistically, the anticipation focus value which serves as a best focus at the time of exposure is computed, and it has further the focal value setting process of setting up a focal value based on the anticipation focus value concerned, and is constituted.
[0008] The amendment method of the focus concerning the 3rd invention is set to the amendment method of the focus the 2nd invention. the aforementioned data accumulation process The sum of the aforementioned focal value and the amount of gaps from the aforementioned best focus is defined as a true amount of gaps. The process which accumulates the true amount of gaps concerning two or more sets of products as data is included. the aforementioned focal value setting process The true amount of gaps concerning the product of the number of predetermined groups is extracted out of the data accumulated at the aforementioned data accumulation process, and it is characterized by making the average of the true amount of gaps concerning the product of the predetermined group concerned into the aforementioned anticipation focus value.
[0009] The amendment method of the focus concerning the 4th invention is set to the amendment method of the focus the 2nd invention. the aforementioned focal value setting process The true amount of gaps concerning the product of the number of predetermined groups is computed from from among the accumulated aforementioned data. The value proportional to the difference of the true amount of gaps about at least 2 sets of products manufactured just before or after the average of the true amount of gaps concerning the product of the number of predetermined groups concerned in two

or more aforementioned sets of products is applied, and it is characterized by making the sum into the aforementioned anticipation focus value.

[0010] The amendment method of the focus concerning the 5th invention is set from the 1st to either of the amendment methods of the focus the 5th invention. The inclination of the aforementioned shot is computed based on the amount of gaps from the best focus value of the aforementioned resist pattern in each point which arranges two or more aforementioned marks for focal measurement to one shot and by which the aforementioned mark for focal measurement is arranged. It is characterized by asking for the aforementioned anticipation focus **** in consideration of the inclination concerned.

[0011] The amendment method of the focus concerning the 6th invention is characterized by to compute the aforementioned anticipation focus value in either of the amendment methods of the focus the 4th invention based on the value which arranges the aforementioned mark for focal measurement to the periphery and the core of one shot, and is between the true amount of gaps of the best focus in the periphery of the aforementioned shot, and the amount of gaps from the best focus value in a core from the 1st.

[0012] the weight [amount / of the best focus which the amendment method of the focus concerning the 7th invention arranges the aforementioned mark for focal measurement from the 1st to two or more / in one shot / in either of the amendment methods of the focus the 4th invention, and is measured by two or more aforementioned places / true / of gaps] according to the pattern layout in the aforementioned shot, or arrangement -- the price -- it is characterized by to compute the aforementioned anticipation focus value by carrying out ******** processing

[0013] The amendment method of the focus concerning invention of the octavus is set from the 1st to either of the amendment methods of the focus the 7th invention. The aforementioned mark for focal measurement is arranged or more to at least one in one shot. It is characterized by calculating the amount of remains curvatures of the aforementioned wafer, considering the amount of remains curvatures concerned, and calculating the aforementioned anticipation focus value from the amount of gaps of the aforementioned mark for focal measurement formed in several places in a wafer by two or more exposure.

[0014] The aforementioned mark for focal measurement is characterized by being the polygon in which the amendment method of the focus concerning the 9th invention has at least one or more angles of 90 or less degrees in either of the amendment methods of the focus invention of the 1st to the octavus.

[0015] The manufacture method of the semiconductor device concerning the 10th invention is characterized by manufacturing a semiconductor device using the aligner by which a focal amendment is carried out from the 1st using the amendment method of one focus of the 9th invention.

[0016]

[Embodiments of the Invention] The amendment method of the focus by the gestalt 1 of operation is explained using drawing 32 from drawing 1 below gestalt 1. of operation. Drawing 1 is the conceptual diagram showing the relation of the field (only henceforth a shot) and the mark for focal measurement by which the shot was carried out to the wafer. In drawing 1 , two or more shots 2 are arranged by exposure of multiple times to one wafer 1. Since at least one mark 3 for focal measurement is formed to one shot 2, although two or more marks 3 for focal measurement are formed in a wafer 1, in drawing 1 , a part of illustration of the mark 3 for focal measurement is omitted. The mark 3 for focal measurement is formed using the reticle on which the figure 100 which carried out the flat-surface configuration as shown in drawing 2 is drawn. If it is disregarded that the nose of cam of angle 4 can be deleted, it can be considered that the figure 100 of drawing 2 is the hexagon which has the angle with angle 4 smaller than 90 degrees. The length of the longitudinal direction of this figure 100 is 10 micrometers, and full is 0.5 micrometers. It has a portion with a width of face of 0.5 micrometers in right and left up to the place of 1 micrometer of right and left from the center position O of the longitudinal direction of the long mark 3 for focal measurement. The mark 3 for focal measurement is thin linearly, and the width of face at a nose of cam has become 0.1 micrometers as it goes to an edge exceeding 1 micrometer of right and left from Center O.

[0017] The resist film applied on the wafer 1 is repeated and exposed by the predetermined pattern which arranges the shot 2 including the mark 3 for focal measurement by the aligner (stepper). Patterning is completed by removing the portion which is not **(ed) by the portion **(ed) by light or light from this resist film. In the case of exposure, when the focus of an aligner shifts from the right best focus, the configurations of a predetermined pattern also including the mark 3 for focal measurement change.

[0018] Drawing 3 - drawing 11 are drawings showing the picture which observes the mark 3 for focal measurement with a scanning electron microscope, and is acquired. Drawing 3 - drawing 11 show the state where the mark 3 for focal measurement by which changed the state of a focus, respectively and patterning was carried out was observed by one 10000 times the scale factor of this from across. These marks 3 for focal measurement put in order in parallel four configurations shown in drawing 2 , and are constituted. Drawing 3 shows the mark 3 for focal measurement in a best focus state. As for drawing 4 to drawing 7 , only -0.4, -0.8, -1.2, and -1.6 (micrometer) show the mark 3 for focal measurement formed after the focus had shifted from the best focus, respectively. on the other hand -- drawing 8 - drawing 11 -- respectively -- 0.4 from a best focus, 0.8, and 1. -- the mark 3 for focal measurement in which only 2 and 1.6 (micrometer) were formed after the focus had shifted is shown Moreover, drawing 12 - drawing 20 are also drawings showing the picture which observes the mark 3 for focal measurement of four with a scanning electron microscope, and is acquired. However, drawing 12 - drawing 20 show the state where the mark 3 for focal measurement by which changed the state of a focus, respectively and patterning was carried out was observed by one 7500 times the scale factor of this from right above. Drawing 12 shows the mark 3 for focal measurement in a best focus state. As for drawing 13 to drawing 16 , only -0.4, -0.8, -1.2, and -1.6 (micrometer) show the mark 3 for focal measurement formed after the focus had shifted from the best focus, respectively. on the other hand -- drawing 17 - drawing 20 -- respectively -- 0.4 from a best focus, 0.8, and 1. -- the mark 3 for focal measurement in which only 2 and 1.6 (micrometer) were formed after the focus had shifted is shown

[0019] Drawing 3 - drawing 20 show that the length of the longitudinal direction of the mark 3 for focal measurement tends to become short as the amount of gaps from a best focus becomes large. When the reticle by which the mark 3 for focal measurement shown in drawing 2 is drawn is used, the length of a longitudinal direction is set to about 8 micrometers in the state of a best focus. However, the length of a longitudinal direction becomes short about 1.5 micrometers by 1-micrometer defocusing. Thus, the relation between the length of the longitudinal direction of the mark for focal measurement and defocusing is investigated, and the graph which indicated a characteristic curve applicable to two or more sets of products which can be regarded as stepper processing having accomplished on the same conditions beforehand like drawing 21 is created and prepared. For example, the grade of defocusing can be judged by measuring the length of the longitudinal direction of the mark 3 for focal measurement by which patterning was carried out using a scanning electron microscope (henceforth SEM). Drawing 22 is the conceptual diagram showing the composition of SEM. SEM10 emitted the electron and is equipped with the electron gun 11 which converges in the shape of a beam. A condensing lens 14 extracts thinly the electron beam which came out of this electron gun 11, and after that, a deflecting coil 15 deflects an electron beam so that the scanning electron beam 16 may scan a wafer 1 top. Although a secondary electron will be emitted from the front face of a wafer 1 if the scanning electron beam 16 hits the front face of a wafer 1, SEM10 catches this secondary electron with the secondary electron detector 17, changes the amount of a secondary electron into the luminosity of the scanning line of the Braun tube 18, and projects the irregularity of the front face of a wafer 1. An image as shown in drawing 3 - drawing 20 is observable with such SEM10.

[0020] By the way, although the grade of defocusing can be distinguished when the length of the longitudinal direction of the mark 3 for focal measurement is measured, judgment of whether to have shifted in the negative direction whether it has shifted in the right direction cannot be performed. Then, the length of the taper section 20 as shown in drawing 12 in order to judge whether it has shifted in which direction of positive/negative from the image observed by SEM10 for example, is measured. Drawing 23 is drawing for explaining the relation between a SEM picture and secondary electron signal wave type. By the SEM picture of drawing 23 (a), the taper section 20 and a flat part 21 can be distinguished. For example, in the SEM picture of drawing 23 (a), dispersion of a secondary electron becomes large in the taper section 20 which becomes thin as the thickness of the resist of the mark 3 for focal measurement goes to the edge of the mark 3 for focal measurement. Therefore, from the secondary electron signal wave type (refer to drawing 23 (b)), the taper section 20 and a flat part 21 can be distinguished clearly, and the length of the taper section 20 can be measured. Drawing 24 is a graph which shows the relation between the length of the taper section, and the gap from a base focus. The graph of drawing 24 summarizes the inclination of change of the length of the taper section 20 shown in drawing 11 from drawing 3 about the case where a negative type resist is used. or [that the length of the taper section 20 hardly changes when the focus has shifted in the negative direction] -- or there is an inclination which decreases for a while On the other hand, when the focus has shifted in the right direction, the length of the taper section 20 becomes long as the grade of defocusing becomes large. The direction of defocusing can be distinguished by such difference. In addition, when the amount of gaps is negative, the length of the taper section 20 increases the relation between the length of the taper section 20 in the case of using a positive type resist, and the amount of gaps from a best focus.

[0021] The judgment procedure of the amount of gaps from the above best focus can be packed into a flow chart like drawing 25 . First, patterning of the resist is carried out using the reticle by which the mark for focal measurement is arranged. The length of the longitudinal direction of the mark 3 for focal measurement by which patterning was carried out is measured by SEM10 (step ST 1). From the measurement result of a step ST 1, it shifts using the relation between the amount of gaps of a focus, and the length of the longitudinal direction of the mark 3 for focal measurement, and an amount is determined (step ST 2). Next, the length of the taper section 20 of the mark 3 for focal measurement is measured by SEM10 (step ST 3). The direction of defocusing is determined from the measurement result of a step ST 3 (step ST 4). Thus, if drawing corresponding to the mark 3 for focal measurement is drawn to the reticle, since it is in the middle of manufacture, a product is extracted and the amount of gaps of a focus can be judged, based on the amount of gaps of the focus of the lot, a focal value can be set up to the lot manufactured by the degree of the lot.

[0022] Next, the production system which manufactures a semiconductor device is explained, processing statistically the data about the amount of gaps of the focus of the past lot. Drawing 26 is the block diagram showing an example of a production system. The main part 31 of a production control system which performs manufacture management of a semiconductor device is in a production system, and the semiconductor fabrication machines and equipment 32 of a stepper 34, SEM10, or others are connected to this main part 31 of a production control system through the terminal 33 for reference. The stepper 34 and semiconductor fabrication machines and equipment 32 which are connected to this main part 31 of a production control system, and SEM10 may be plural, respectively. There are a sputtering system, an etching system, etc. in semiconductor fabrication machines and equipment 32. In a production control system 10, two or more semiconductor integrated circuits are formed on a wafer 1 using the semiconductor fabrication machines and equipment 32 of a stepper 34 or others. To an erector degree etc., a semiconductor device attaches a leadframe, a lead, a package, etc. in this semiconductor integrated circuit, and is formed in it. The main part 31 of a production control system manages the data about a focus obtained from this stepper 34, SEM10, etc. The amount of gaps of a focus is contained in the data about a focus, and the data about a focus are stored in database 31b of the main part 31 of a production control system. Focal amendment section 31a of the main part 31 of a production control system calculates the anticipation focus value for rectifying a focus using the data stored in database 31b.

[0023] The data of data number i=1-4 as shown in drawing 27 are kept by database 31b of the main part 31 of a production control system. These data show that it is the past data, so that a data number is small, set the data (henceforth the newest data) of the past near this time to i= 1, and enumerate them in order. For example, focal amendment section 31a calculates the average of the data of data number i=1-4, and the focal value Pr 1 of a stepper 34 is set up based on the average acquired by performing statistical processing. that is, S0 and each focal value were measured by Si and SEM10 in the anticipation focus value -- if it shifts and an amount is expressed with " (-Ki) -- an anticipation focus value -- S0=sigma(Si-Ki)/n .... (formula 1) -- it is come out and given Here, total (sigma) is given with the value to which the value in () totaled all the values at the time of i= 1 to i=n. The procedure of this calculation sorts out the data about the focus used for the calculation first as collected into the flow chart of drawing 28 (step ST 11). Since products differ or some which become old too much are also in the data about a focus, only what is used for calculation is sorted out in accordance with predetermined criteria. Here, four new data including the newest data are extracted. That is, in the case of this example, the data of four newest lots as the predetermined number of groups are extracted. These data are products it is considered that are those by which stepper processing was made on the same conditions. if it puts in another way, these data should pass the same history (the process which forms the film of the same thickness by the film of the same kind, and process which adds the same heat history) -- it is the formed product Next, the true amount of gaps of a focal value is calculated (step ST 12). Since the amount of gaps (-Ki) measured by SEM10 is the amount of gaps from the focal value set up last time, a gap is small shown only for the part of the focal value set up last time to the true amount of gaps. Then, it is necessary to compute the true amount (Si-Ki) of gaps by rectifying the focal value set up last time about the amount of gaps measured by SEM10. Next, the average of the true amount of gaps is calculated by only the predetermined number of times (for example, 4 times) going back in front from the newest data (step ST 13). Thus, the calculated value turns into a focal value (henceforth an anticipation focus value) used for next exposure.

[0024] An anticipation focus value can also consider and ask for change between new data. For example, using data i=1-4 shown by drawing 27 , as shown in drawing 29 , the anticipation focus value Pr 2 can be set up. That is, the value VA 2 which doubled the difference VA 1 of the true amount of gaps which the newest data i= 1 and the data i= 2 in front of it show q is added to the average of data i=1-4, and the anticipation focus value Pr 2 is determined. Generally, the anticipation focus value S0 is. S0=sigma(Si-Ki)/n+qx {(S1-K1)- (S2-K2)} .... (formula 2)

It is come out and given. Hereafter, an average term and the term of qx {(S1-K1)- (S2-K2)} are called change term for this term of sigma (Si-Ki)/n shown in a formula 2. n of a formula 1 and a formula 2 and q are constants suitably set up for every statistical calculation. For example, as for n, carrying out to three or more is desirable, and, as for q, it is desirable to set it as the value to which dispersion in the amount of gaps from a best focus becomes the smallest. The desirable constants n and q can be experientially drawn, while repeating statistical calculation. Thus, by calculating an anticipation focus value reflecting a change term, it can bring close to the true amount of gaps with the expected true actual amount of gaps, and the accuracy of a focal amendment can be improved compared with the case of a formula 1. In addition, generally a change term is sigmaqjx[(Sj-Kj)-{(S(j+1)-K(j+1)} it can express] and not only processing and processing before last of the last time of the processing but the processing before second from last time may be made to reflect in calculation). In that case, you may set up the value of a constant qj individually. You may not be the last data although it is desirable to use the last data when using the difference of the true amount of gaps. The calculation procedure of an anticipation focus value is explained using the flow chart of drawing 30 . First, the average of the true amount of gaps as well as the case where the average is used as an anticipation focus value is calculated by extracting the data (data about the true amount of gaps) about the focal value of the suitable past from database 31b (Steps ST11-ST13). Furthermore, a change term is calculated using the data extracted from database 31b (step ST 14). The change term taken out with a step ST 14 is added to the average computed at a step ST 13, and the anticipation focus value S0 is calculated (step ST 15). The true amount of gaps is computed from the amount of gaps from the best focus for which it asked from measurement by SEM10 etc. (-Ki), the value is substituted for a formula, and comparison of the case where the anticipation focus value S0 of a next lot is calculated, and the case (when a focal value is fixed) where a setup of a focal value is not carried out is shown in drawing 31 . By using the anticipation focus value S0 calculated using the formula 2, the average of the amount of gaps from a best focus approaches 0, change is small and a bird clapper is known.

[0025] Gestalt 2. drawing 32 of operation is the plan showing the relation of the shot and the mark for focal measurement in the amendment method of the focus of the gestalt 2 operation. As shown in drawing 32 , the marks 3a-3d for focal measurement are arranged in the four corners of a shot 2. Fixed distance Dy (micrometer) is all among the marks 3b and 3d for focal measurement between the marks 3a and 3c for focal measurement, and there is all fixed distance Dx (micrometer) among the marks 3c and 3d for focal measurement between the marks 3a and 3b for focal measurement. Moreover, the same y-coordinate up has mutually the marks 3a and 3b for focal measurement, and the marks 3c and 3d for focal measurement are also on the same y-coordinate as each other. The same x-coordinate up has mutually the marks 3a and 3c for focal measurement, and the marks 3b and 3d for focal measurement are on the same X coordinate as each other. X component of the inclination of a shot 2 is defined by how much the straight line which connects the middle point of the marks 3a and 3c for focal measurement and the marks [for focal measurement / 3b and 3d] middle point leans to the straight line passing through the middle point which are the marks 3b and 3d for focal measurement parallel to the X-axis. That is, the X component Ex of an inclination is, when the true amount of gaps of a marks [for focal measurement / 3a-3d] focus is made into Sa-Sd (micrometer). $Ex= \{(Sa+Sc)/2-(Sb+Sd)/2\}/Dx$ .... (formula 3)

It is come out and given. Similarly, Y component of the inclination of a shot 2 is defined by how much the straight line which connects the middle point of the marks 3a and 3b for focal measurement and the marks [for focal measurement / 3c and 3d] middle point leans to the straight line passing through the middle point which are the marks 3c and 3d for focal measurement parallel to a Y-axis. Namely, Y component Ey of an inclination $Ey= \{(Sa+Sb)/2- (Sc+Sd)/2\}/Dy$ .... (formula 4)

It is come out and given. The unit of these inclinations Ex and Ey is a radian.

[0026] An amendment of these inclinations Ex and Ey as well as the gestalt 1 of operation can be predicted. When the correction value of XY component of an inclination is expressed as Fxi and Fyi, the average is used for the anticipation inclination correction value Fx0 and Fy0, and it is $Fx0=sigma(Fxi-Exi)/n$, respectively. .... (formula 5)

Fy0=sigma(Fyi-Eyi) n .... (formula 6)
It is come out and given.

[0027] Moreover, the anticipation inclination correction value Fx0 and Fy0 seasons the average with a change term, and is each. Fx0=sigma(Fxi-Exi) n +qxx {(Fx1-Ex1)- (Fx2-Ex2)} .... (formula 7)
Fy0=sigma(Fyi-Eyi)/n +qyx {(Fy1-Ey1)- (Fy2-Ey2)} .... (formula 8)
It is come out and given. This n, qx, and qy are a constant suitably set up for every statistical calculation. performing statistical calculation like a formula 7 and a formula 8 using the data of the lot of the past of the values Ex and Ey of this inclination component -- anticipation inclination correction value (Fx0, Fy0) -- computing -- this prediction inclination correction value Fx0 and Fy0 -- using -- the main part 31 of a production control system -- the inclination of the shot of a stepper 4 -- an amendment -- the precision of an inclination amendment can be raised by things Drawing 33 is a graph which shows change of Y component of an inclination for comparing the case where it does not carry out with the case where an inclination amendment of a shot is performed. From drawing 33 , as for by performing an inclination amendment, the average of an inclination approaches 0 and the width of face of change also shows that it is small. In addition, although the gestalt 2 of the above-mentioned implementation explained the case where the mark 3 for focal measurement was four, if there are at least three, the flat surface of a shot 2 is specified and an inclination component can be computed, respectively.

[0028] Gestalt 3. drawing 34 of operation is the plan showing the relation of the shot and the mark for focal measurement in the gestalt 3 of operation. Drawing 35 is the conceptual diagram of the curvature of field for explaining the outline of the focal amendment by the gestalt 3 of operation. In order to give explanation easy, in drawing 35 , the curve of a shot 2 is actually emphasized also for the twist. As for the image of a shot 2, a core draws the smooth surface of a convex. The edge of a shot 2 and a core change in the position to which an image is connected with curvatures of field which the lens of a stepper 4 has. Therefore, setup used as a best focus also differs. That is, even if it is in a best focus state by the marks 3a-3d for focal measurement, mark 3e for focal measurement of a core will separate only from the part of a curvature of field from a best focus. Then, the flat surface PL which intersects the straight line which connects mark 3e for focal measurement and the marks 3a-3d for focal measurement is assumed, and it sets up so that the amount of gaps from the best focus in the flat surface PL may become the minimum from the amount of gaps from the best focus in the edge of a shot 2, and the amount of gaps from the best focus in a core.

[0029] For example, if the amount of gaps of the mark 3a-3e truth for focal measurement is expressed as Sa-Se, it is the amount Sp of gaps of a flat surface PL. Sp= {Se- (Sa+Sb+Sc+Sd)/4}/2 .... (formula 9)
It is come out and given. Thus, by bringing close to a best focus in consideration of a curvature of field, the whole shot 2 can be brought close to the state of a best focus compared with the case where the edge or core of a shot 2 is made into a best focus state. In addition, although the imagination flat surface PL is arranged to 1/2 of the places of a gap of an edge and a core in the above-mentioned explanation, it does not restrict to the place of 1/2, and it may bring close to either an edge or a core, and you may arrange.

[0030] An amendment of this flat surface PL can also be predicted. When the amount of gaps of the flat surface PL calculated from the amount of gaps measured by Si and SEM10 in the focal value is expressed as (-Spi), the average is used for the anticipation focus value S0, and it is S0=sigma(Si-Spi)/n. .... (formula 10)
It is come out and given.

[0031] Moreover, the anticipation focus value S0 seasons the average with a change term.
S0=sigma(Si-Spi)/n +qx {(S1-Sp1)- (S2-Sp2)} .... (formula 11)

It is come out and given. This n and q are a constant suitably set up for every statistical calculation. Using the data of the lot of the past of this amount Sp of gaps, by performing statistical calculation like a formula 10 and a formula 11, when the anticipation focus value S0 is predicted and the main part 31 of a production control system sets up a stepper 4 using this anticipation focus value S0, the precision of a focal amendment can be raised.

[0032] Also in the amendment method of the focus by the gestalt 4 of gestalt 4. implementation of operation, as shown, for example in drawing 36 , two or more marks 3-1 for focal measurement - 3-m are arranged in one shot 2. In drawing 36 , the illustration ellipsis of the mark 3-3 to 3-j-1 for focal measurement, and 3-j+1 - 3-m is carried out. The dimensional accuracies for which the field of the circumference where each mark 3-1 for focal measurement - 3-m are arranged is needed may differ, respectively. For example, as for the field Arj around mark 3-j for focal measurement, close dimensional accuracy is required rather than the field Arn around mark 3-n for focal measurement. In this case, if the true amount of gaps of mark 3-j for focal measurement and the true amount of gaps of mark 3-m for focal measurement are similarly treated, specification may not no longer be fulfilled in the field Arj of which close dimensional accuracy is demanded influenced by mark 3-n for focal measurement of a gap.

[0033] Then, it carries out with weight so that the amount of gaps of the mark for focal measurement of the place near the field of which close dimensional accuracy is required may be made to reflect in a setup of a focal value greatly and the amount of gaps of the mark for focal measurement of the place near the field of which a low dimensional accuracy is required conversely may not be made to reflect in a setup of a focal value not much.

[0034] If the amount of gaps of the focus obtained by giving weight (-H) makes the amount of gaps measured by SEM10 of the mark 3-1 for focal measurement - 3-m - (-G1) (-Gm)
H=(k1xG1+k2xG2+--+kmxGm)/(k1+k2+--+km) .... (formula 12)
It is come out and given. In addition, coefficients k1-km can also be made into zero, respectively, and the same result as the mark for focal measurement not having been arranged is obtained in the field of which a low dimensional accuracy is required in that case.

[0035] An amendment of the amount of gaps of the focus obtained by giving this weight (-H) can also be predicted. When a focal value is expressed as Si, the average is used for the anticipation focus value S0, and it is S0=sigma(Si-Hi)/n. .... (formula 13)
It is come out and given.

[0036] Moreover, the anticipation focus value S0 seasons the average with a change term.
S0=sigma(Si-Hi)/n +qx {(S1-H1)- (S2-H2)} .... (formula 14)
It is come out and given. This n and q are a constant suitably set up for every statistical calculation. Using the data of the lot of the past of this amount Hi of gaps, by performing statistical calculation like a formula 13 and a formula 14, when the anticipation focus value S0 is predicted and the main part 31 of a production control system sets up a stepper 4 using this anticipation focus value S0, the precision of a focal amendment can be raised.

[0037] The amendment method of the focus by the gestalt 5 of gestalt 5. implementation of operation is the amendment which took the curvature of a wafer into consideration. As shown in drawing 37 , a difference is possible for the height of outermost periphery 1b of a wafer 1, and core 1a. In order to perform the amendment method of the focus by the gestalt 5 of operation in consideration of the difference in this height, it is necessary to classify the mark for focal measurement respectively formed on a wafer at the shot by which multiple-times irradiation is carried out according to the position on a wafer. For example, the shots 2a-2d of drawing 1 are shots currently irradiated by wafer 1 outermost periphery 1b, and the marks 3p-3s for focal measurement formed of the shots 2a-2d are classified into a set of the mark arranged at outermost periphery 1b. On the other hand, shot 2e of drawing 1 is a shot currently irradiated by core 1a of a wafer 1, and it is classified into a set of the mark arranged at core 1a mark 3t for focal measurement formed of the shot 2e. The amount J of remains curvatures of a wafer 1 is defined by the difference (J=W1-W2) of the amount W1 of gaps from the best focus of the shot of core 1a of a wafer 1, and the amount W2 of gaps from the best focus of the shot of outermost periphery 1b of a wafer 1. The amount of gaps of each shot to a best focus may be given in approximation in the amount of gaps of the mark for focal measurement in one shot, and may be given in approximation by the average of the amount of gaps of two or more marks for focal measurement. When the amount of gaps of a shot is represented with the amount of gaps of one mark for focal measurement, as for the position in the shot of the mark for focal measurement, unifying between shots is desirable. For example, it is given with the difference of the amount of gaps from a marks [for focal measurement / 3p-3s] best focus, and the amount of gaps from a mark 3t [for focal measurement] best focus. The amount of gaps from a marks [in outermost periphery 1b / for focal measurement / 3p-3s] best focus may be calculated from one mark for focal measurement, and may average and calculate the amount of gaps of two or more marks for focal measurement. Usually, since leveling of a wafer 1 is performed correctly, even if it uses one mark for focal measurement in outermost periphery 1b, the height of outermost periphery 1b can be represented almost surely.

[0038] The amount J of remains curvatures of a wafer 1 can be similarly predicted to be the amount S0 of gaps from the best focus in the gestalt 1 of operation. The average of the data Ji (i=1-n) of the past memorized by database 31b is used for the amount J0 of prediction remains curvatures, and it is
J0=sigmaJi/n. .... (formula 15)
It is come out and given. Or the amount J0 of prediction remains curvatures considers a change term.
J0=sigmaJi/n+qx (J1-J2) .... (formula 16)
It is come out and given. In addition, the past data Ji used for one statistical calculation must be what passed through the same history at least. For example, if the membranous kind and membranous thickness which are formed on a wafer 1 similarly have the same heat history that what is necessary is just a product of the same kind even if it is not a product of the same kind, it is possible to deal with it as what passed through the same history.

[0039] Formula of the focal value M of each shot in the wafer 1 in consideration of this amount J0 of prediction remains curvatures M=J0x(distance from center of wafer 1 of shot of distance wafer outermost periphery from center of wafer 1 of each shot) xW1 .... (formula 17)
It is come out and given. If the focal value M calculated by this formula 17 is used as a focal value of each shot at the time of exposure, improvement in precision can be aimed at compared with the case where the amount of gaps of one shot 2 in a wafer 1 is used as a focal value of all the shots 2, and simplification of measurement and calculation can be attained compared with the case where repeat measurement and calculation every shots 2 of all in a wafer 1, and a focal value is calculated.

[0040] In addition, in statistical processing of the data explained with the gestalten 1-5 of operation, you may add processing which is explained below. Drawing 38 is a graph which shows the relation between the turn of the processed lot, and the true amount of gaps of the lot concerned. The data shown in the graph of drawing 38 are data sorted out through the same process as the step ST11 grade of drawing 28 . The true amount of gaps of a data number i+2 shown in drawing 38 is projected from the true amount of gaps of other data numbers. This is presumed to be what the error of the measurement in malfunction of a stepper 4 and superposition test equipment 5, an operator's failure, etc. produced owing to. If anticipation stepper correction value is computed using the true amount of gaps of this data number i+2 as it is, as a solid line shows to drawing 39 , data number i and the stepper set point of i+1 will become larger than the optimal stepper set point, and possibility that data number i and the data of i+1 will shift from a specification value following the data of a data number i+2 will become large. Thus, since the failure of the operator who is the cause by which a value shifts greatly etc. is transient and the value is large, the influence which it has on calculation of anticipation stepper correction value is large, and not being repeated with the following lot is a usual state. Therefore, when anticipation stepper correction value is calculated by considering such data, possibility that the precision of a focal amendment will get worse on the contrary is large, therefore possibility of separating from a specification value as a solid line shows to drawing 40 becomes large.

[0041] In the amendment method of the focus of the gestalten 1-5 operation, unusual data like a data number i+1 shown in drawing 38 can be eliminated from calculation of anticipation stepper correction value. Drawing 41 is a flow chart which shows the procedure. Processing shown in drawing 41 is performed in case data are registered into database 31b. First, at a step ST 301, sorting of data is performed like the step ST 11 of drawing 28 . Next, at a step ST 302, the one newest data is extracted out of the data sorted out. The newest data are the newest in each group which is used for calculation of each anticipation stepper correction value and which was sorted out. At a step ST 302 The amount of filters = the true amount of gaps in front of amount of gaps - of the truth immediately after measurement of the amount of gaps by SEM The calculation -- (formula 18) is performed. Here, the last true amount of gaps is data extracted at a step ST 302. At a step ST 304, the comparison test of the amount of filters which calculated and obtained the formula 18 in a step ST 303, and the predetermined specification value is carried out. For example, in the case of the amount of specification value > filters, a judgment result is considered as success (O.K.). On the other hand, in the case of the amount of specification value <= filters, a judgment result is made into rejection (NG). When judged with a rejection, it progresses to a step ST 305, and it is the same as the true amount of gaps immediately after measurement of the amount of gaps by SEM, and the flag which shows judgment result rejection (NG) is inputted. That is, it is shown that the data about the true amount of gaps to which the flag was given are a judgment result rejection. The data to which such a flag was given are set up so that it may not sort out in the step ST 201 of drawing 28 . The filter ability which removes unusual data can be given by performing such a setup.

[0042] A dashed line shows the measurement result of the amount of gaps by the stepper set point and SEM at the time of applying such filter ability to drawing 39 and drawing 40 . Since the data of a data number i+2 are eliminated from the data used for calculation and are not reflected in anticipation stepper correction value by applying filter ability, the stepper set point does not become larger than required, but possibility that the measurement result of the amount of gaps by SEM will also be settled in a specification value becomes high. That is, that filter ability gives to the amendment method of a focus will improve and improve the precision of a focal amendment.

[0043] Drawing 42 is a timing chart which shows processing progress of Product A and Product B. An exposure limit is explained using drawing 42 . Product B shall be processed by the stepper 4 following Product A. In case the data of Product A and Product B are sorted out at the step ST 11 of drawing 28 at this time, it is data classified into the same group. When exposing Product B after the exposure processing end of Product A and it is, before measurement of the amount of gaps by SEM about Product A is completed (time t11), after measurement of the amount of gaps by the case where exposure is started, and SEM about Product A is completed, when it is (time t12), there are two kinds with the case where exposure is started of cases. An exposure limit is forbidding exposure processing of the product B before the measurement end of the amount of gaps by SEM (time t11) about Product A, and permitting exposure processing of the product B after the measurement end of the amount of gaps of Product A (time t12). If it does in this way, since the data concerning the focus of Product A cannot be used when possibility that the precision of a focal amendment will be improved becomes high and Product A becomes substandard, since the data concerning the newest focus were surely used in exposure processing of Product B, it can lessen that Product B becomes substandard.

[0044] Drawing 43 is a flow chart which shows the procedure of the exposure limit in the amendment method of a focus. A step ST 401 is a step which sorts out the data concerning a focus as well as a step ST 301. The one data newest at a step ST 402 is extracted following a step ST 401. This step ST 402 is the same as a step ST 302. However, the data extracted and used are the completion flag of the amount measurement processing of gaps by SEM given to the data concerning a focus. This completion flag of measurement processing is inputted in case it registers for example, with database 31b. At a step ST 403, the existence of this completion flag of measurement processing is judged. When the completion flag of measurement processing is not given, in order to forbid stepper processing of the product, the processing prohibition information that exposure processing prohibition disposal is directed is outputted.

[Translation done.]

* NOTICES *

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damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the conceptual diagram showing the relation between a wafer, a shot, and the mark for focal measurement.

[Drawing 2] It is the plan showing an example of the configuration of the mark for focal measurement.

[Drawing 3] It is the pictorial view showing the 1st example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 4] It is the pictorial view showing the 2nd example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 5] It is the pictorial view showing the 3rd example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 6] It is the pictorial view showing the 4th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 7] It is the pictorial view showing the 5th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 8] It is the pictorial view showing the 6th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 9] It is the pictorial view showing the 7th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 10] It is the pictorial view showing the example of the octavus of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 11] It is the pictorial view showing the 9th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 12] It is the pictorial view showing the 10th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 13] It is the pictorial view showing the 11th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 14] It is the pictorial view showing the 12th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 15] It is the pictorial view showing the 13th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 16] It is the pictorial view showing the 14th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 17] It is the pictorial view showing the 15th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 18] It is the pictorial view showing the 16th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 19] It is the pictorial view showing the 17th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 20] It is the pictorial view showing the 18th example of the mark for focal measurement observed by the scanning electron microscope.

[Drawing 21] It is the graph which shows the relation between the amount of gaps from a best focus, and the length of the longitudinal direction of the mark for focal measurement.

[Drawing 22] It is a conceptual diagram for explaining the structure of a scanning electron microscope.

[Drawing 23] It is drawing for explaining the relation between the picture of a scanning electron microscope, and secondary electron signal wave type.

[Drawing 24] It is the graph which shows the relation between the gap from a best focus, and the length of the taper section of the mark for focal measurement.

[Drawing 25] It is the flow chart which shows the measurement procedure of the amount of gaps from a best focus.

[Drawing 26] It is the block diagram showing the composition of a production system.

[Drawing 27] It is the graph which shows an example of the relation of the true amount of gaps and anticipation focus value which are accumulated at the database.

[Drawing 28] It is the flow chart which shows an example of the computational procedure of an anticipation focus value.

[Drawing 29] It is the graph which shows other examples of the relation of the true amount of gaps and anticipation focus value which are accumulated at the database.

[Drawing 30] It is the flow chart which shows other examples of the computational procedure of an anticipation focus value.

[Drawing 31] It is the graph which shows a time change of the amount of gaps from a best focus value.

[Drawing 32] It is the plan showing an example of arrangement of the mark for focal measurement in a shot.

[Drawing 33] It is the graph which shows a time change of the inclination of a shot.

[Drawing 34] It is the ** part view showing other examples of arrangement of the mark for focal measurement in a shot.

[Drawing 35] It is a conceptual diagram for explaining a curvature of field.

[Drawing 36] It is the plan showing other examples of arrangement of the mark for focal measurement in a shot.

[Drawing 37] It is drawing for explaining the amount of remains curvatures of a wafer.

[Drawing 38] It is the graph which shows the relation between the turn of the processed lot, and the true amount of gaps of the lot concerned.

[Drawing 39] It is a graph for explaining the influence a filter affects a focal value.

[Drawing 40] It is a graph for explaining the influence a filter shifts and affect the measurement result of an amount.

[Drawing 41] It is the flow chart which shows the procedure which eliminates unusual data from calculation of anticipation stepper correction value.

[Drawing 42] It is the timing chart which shows processing progress of Product A and Product B.

[Drawing 43] It is the flow chart which shows the procedure of the exposure limit in the amendment method of a focus.
[Description of Notations]
1 A wafer, 2 A shot, 3, 3a-3e, 3p-3t, the mark for 3-1 - 3-m focus measurement, 4 An angle, 20 The taper section, 10 A scanning electron microscope (SEM), 30 A production system, 43 Stepper.

[Translation done.]

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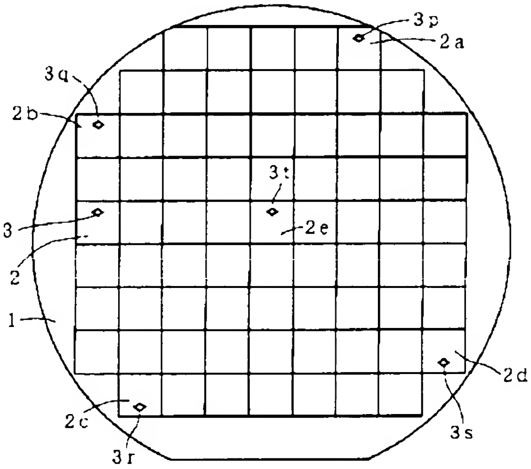
2.**** shows the word which can not be translated.

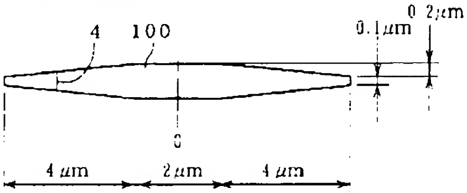
3.In the drawings, any words are not translated.

DRAWINGS

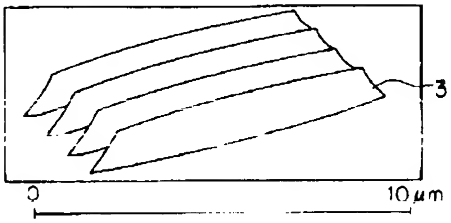
[Drawing 1]


3p
2a
3q
2b
3t
2e
3
2
1
2d
2c
3s
3r

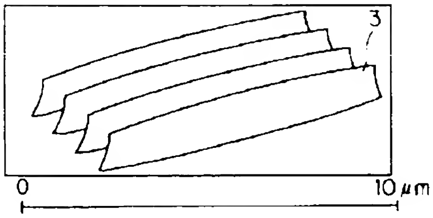
[Drawing 2]


4
100
0.1μm
0.2μm
0
4μm
2μm
4μm

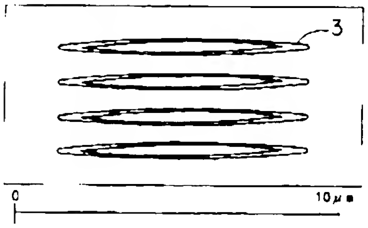
[Drawing 3]



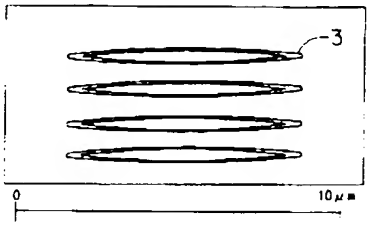
[Drawing 4]



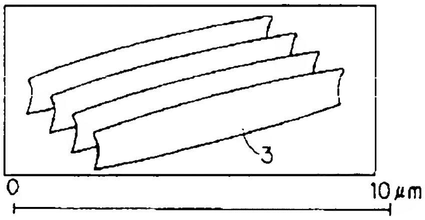
[Drawing 12]



[Drawing 13]



[Drawing 5]



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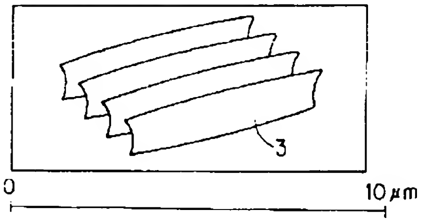
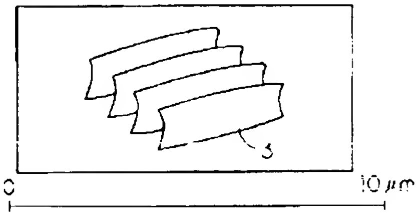
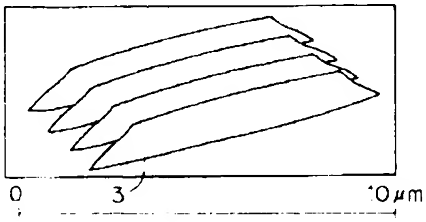


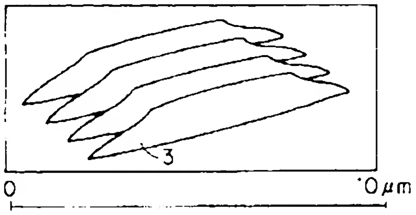
[Drawing 7]



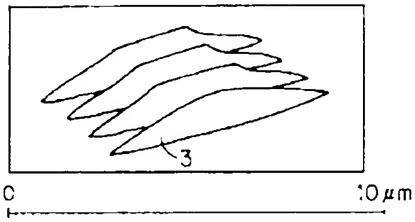
[Drawing 8]



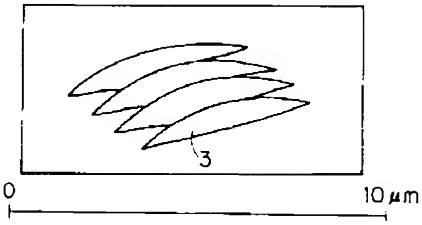
[Drawing 9]



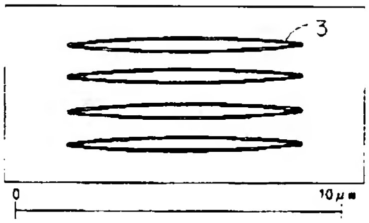
[Drawing 10]



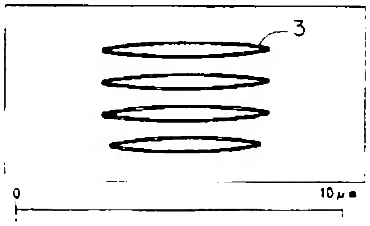
[Drawing 11]



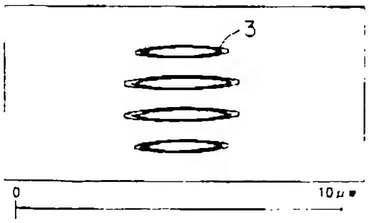
[Drawing 14]



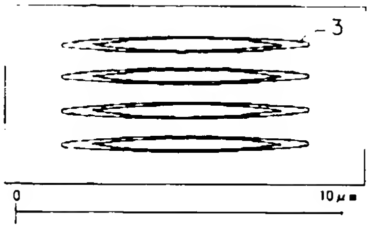
[Drawing 15]



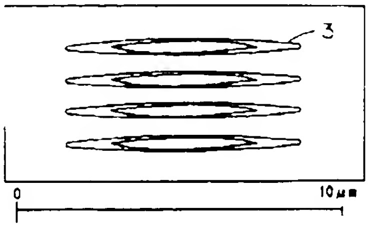
[Drawing 16]



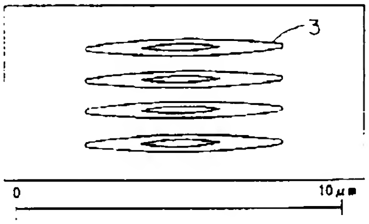
[Drawing 17]



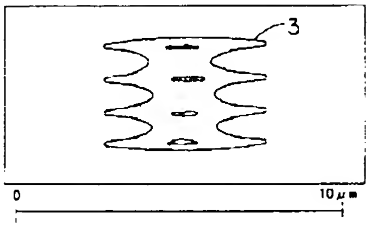
[Drawing 18]



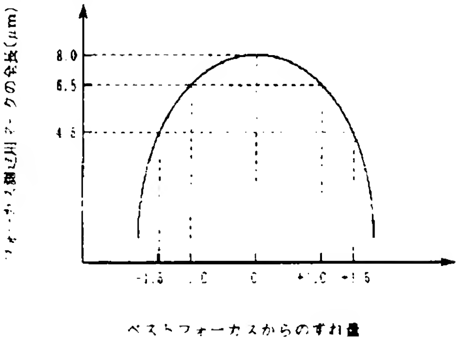
[Drawing 19]



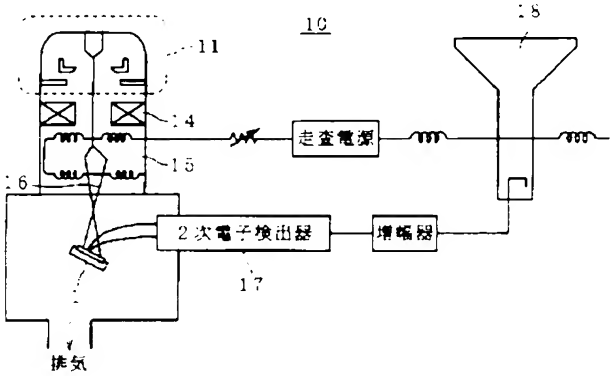
[Drawing 20]



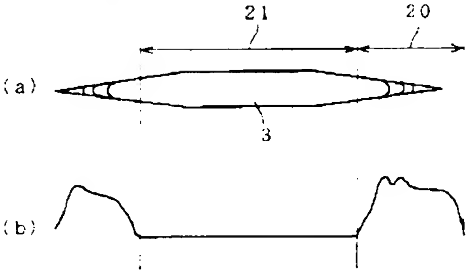
[Drawing 21]



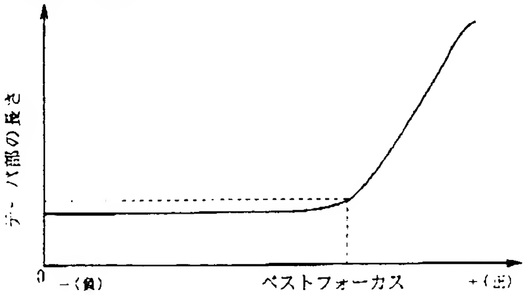
[Drawing 22]


10
11
14
15
16
17
18
走査電源
2次電子検出器
増幅器
排気

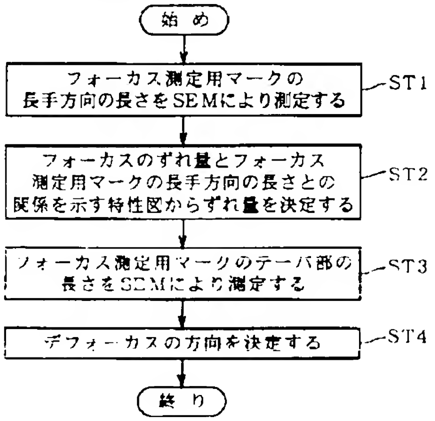
[Drawing 23]



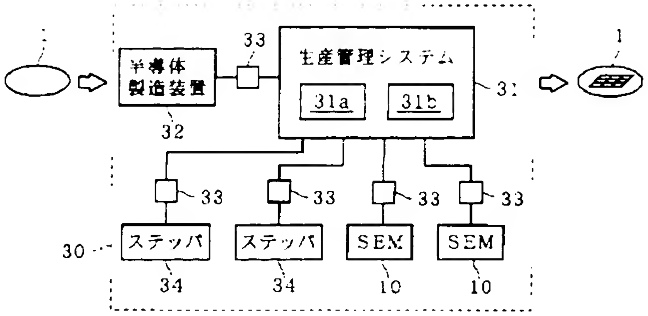
[Drawing 24]



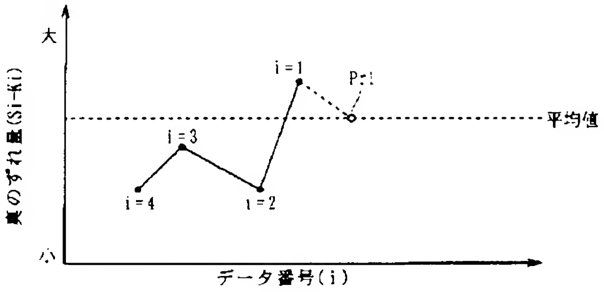
[Drawing 25]


始め
フォーカス測定用マークの長手方向の長さをSEMにより測定する
ST1
フォーカスのずれ量とフォーカス測定用マークの長手方向の長さとの関係を示す特性図からずれ量を決定する
ST2
フォーカス測定用マークのテーパ部の長さをSEMにより測定する
ST3
デフォーカスの方向を決定する
ST4
終り

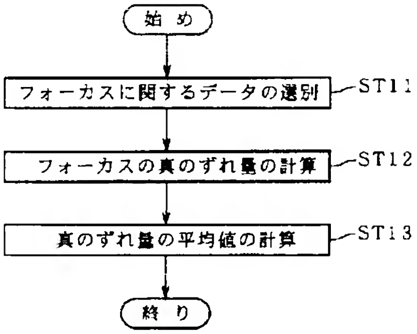
[Drawing 26]


1
33
半導体製造装置
生産管理システム
31a
31b
31
32
33
33
33
33
30
ステッパ
ステッパ
SEM
SEM
34
34
10
10

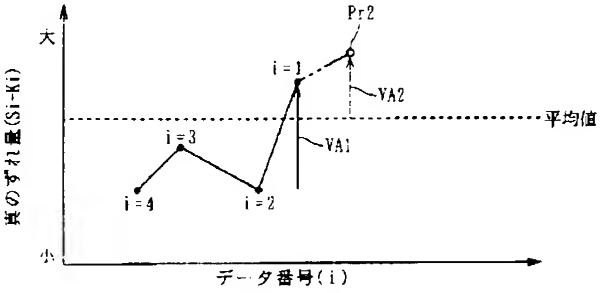
[Drawing 27]



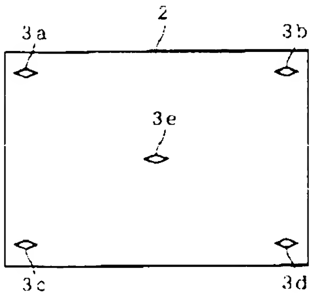
[Drawing 28]


始め
フォーカスに関するデータの選別
ST11
フォーカスの真のずれ量の計算
ST12
真のずれ量の平均値の計算
ST13
終り

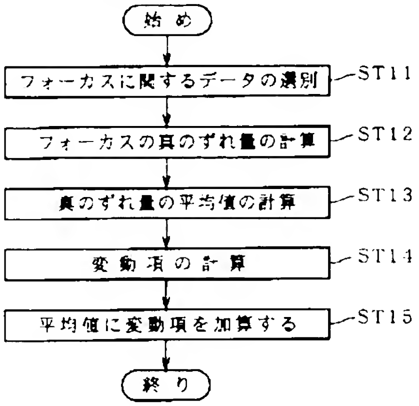
[Drawing 29]



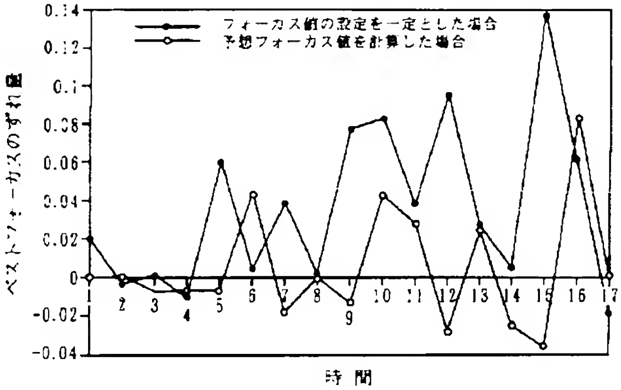
[Drawing 34]


2
3a
3b
3e
3c
3d

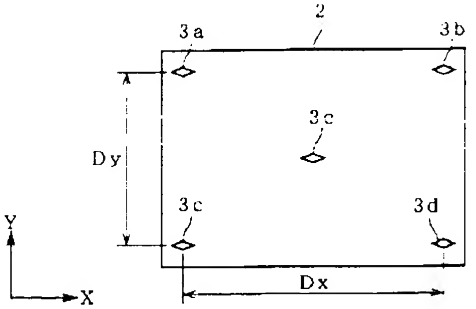
[Drawing 30]


始め
フォーカスに関するデータの選別
ST11
フォーカスの真のずれ量の計算
ST12
真のずれ量の平均値の計算
ST13
変動項の計算
ST14
平均値に変動項を加算する
ST15
終り

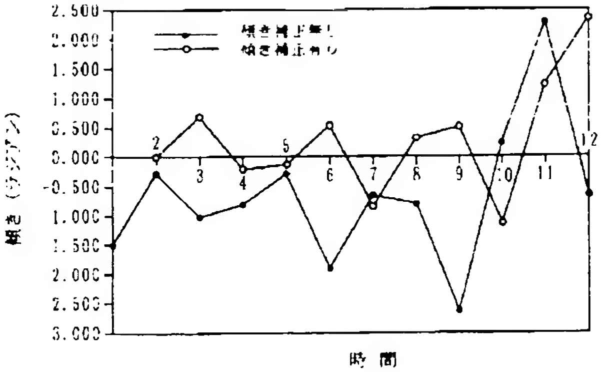
[Drawing 31]



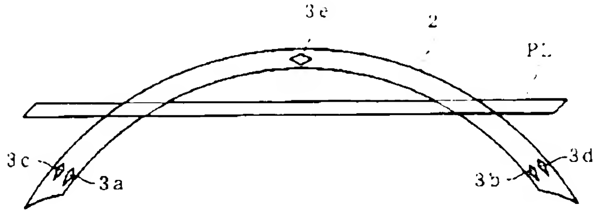
[Drawing 32]


2
3a
3b
3c
Dy
3c
3d
Y
X
Dx

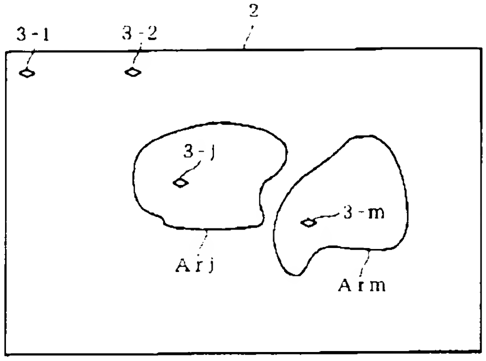
[Drawing 33]



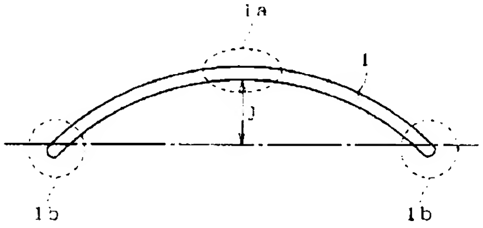
[Drawing 35]


3e
2
PL
3c
3a
3b
3d

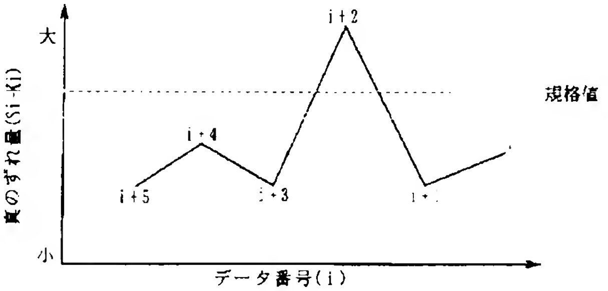
[Drawing 36]


3-1
3-2
2
3-j
3-m
Arj
Arm

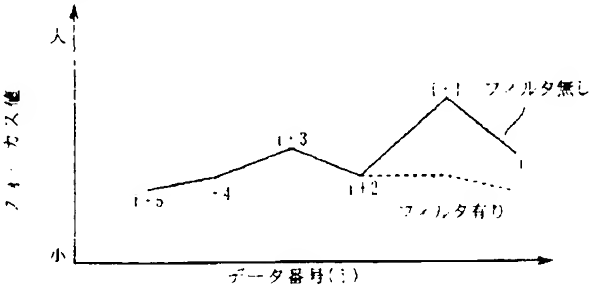
[Drawing 37]



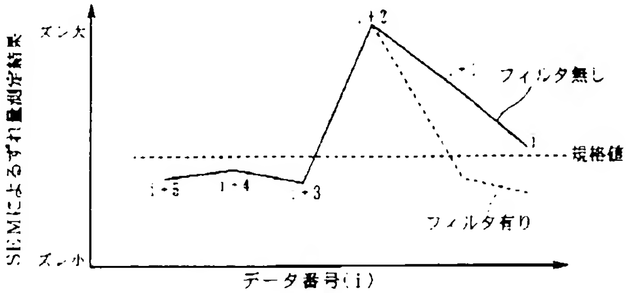
[Drawing 38]



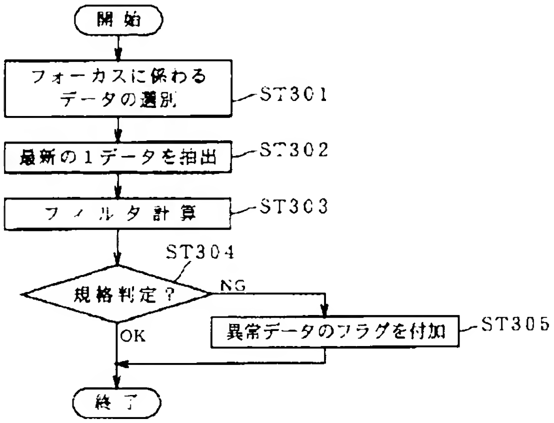
[Drawing 39]



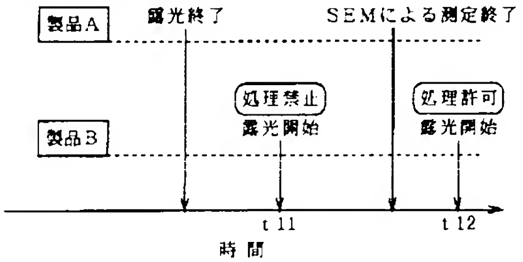
[Drawing 40]



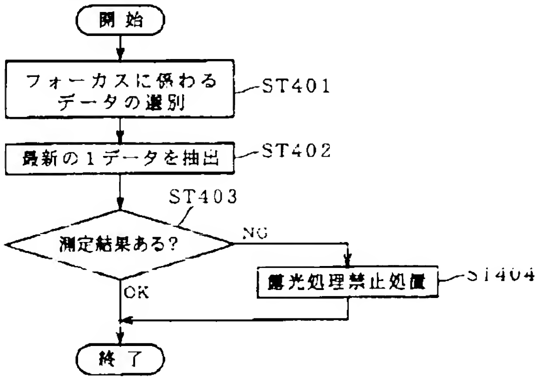
[Drawing 41]


開始
フォーカスに係わるデータの選別
ST301
最新の1データを抽出
ST302
フィルタ計算
ST303
ST304
規格判定？
NG
OK
異常データのフラグを付加
ST305
終了

[Drawing 42]


製品A
露光終了
SEMによる測定終了
処理禁止
露光開始
処理許可
露光開始
製品B
t 11
t 12
時間

[Drawing 43]


開始
フォーカスに係わるデータの選別
ST401
最新の1データを抽出
ST402
ST403
測定結果ある？
NG
OK
露光処理禁止処置
ST404
終了

[Translation done.]

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-288879
(43)Date of publication of application : 19.10.1999

(51)Int.Cl. H01L 21/027
G03F 7/207

(21)Application number : 10-290302
(22)Date of filing : 13.10.1998

(71)Applicant : HITACHI LTD
(72)Inventor : YOKOUCHI TETSUJI
IWATA HISAFUMI

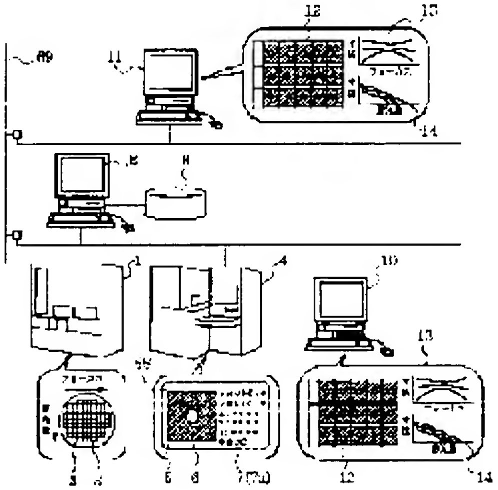
(30)Priority
Priority number : 10 22933 Priority date : 04.02.1998 Priority country : JP

(54) EXPOSURE CONDITIONS DETECTING METHOD AND DEVICE THEREOF, AND MANUFACTURE OF SEMICONDUCTOR DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To realize exposure conditions determining method and a device, where the collection and arrangement of data and the arrangement of pictures are carried out easily, quickly, and accurately without requiring much time for aiding a quick determination of an optimal condition in an optimal exposure conditions determining operation.

SOLUTION: Dimensions and decisions, and images obtained from a microscope device 4, such as a length measuring SEM or the like through a condition finding operation, are collected via a network 6, data on a measuring point, a focus, an exposure amount, dimensions, a pattern decision are linked with images and stored in a data base 9 of a server 8, optimal conditions are automatically determined by the server 8, the data are retrieved and processed with an office PC 11 such as a personal computer installed at an office, and dimensions, a pattern decision, an image, a dimensional characteristics graph, and optimal conditions are made to be



displayed on the screen of the office PC 11.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] the exposure condition determination support method which the size value which carries out condition appearance, and which is acquired with microscope equipment in work and pattern judging which determine the focus in an aligner and the optimal exposure conditions of light exposure, a picture, etc. carry out condition appearance, carries out online collection of the data, and is characterized by what is arranged and displayed on the conditions which acquired the data
[Claim 2] the exposure condition determination support equipment which has the function which carries out online collection of the data from microscope equipment by a size value, a pattern judging, a picture, etc. carrying out condition appearance, the function carry out condition appearance, and save and manage data, and the function put in order and displayed on the conditions which carried out condition appearance, searched data and acquired the data
[Claim 3] the exposure condition determination support method characterized by supporting condition determination by [which determine the focus in an aligner, and the optimal exposure conditions of light exposure] carrying out condition appearance, making a focus and light exposure correspond, and putting in order and displaying a size value and a pattern judging as a microscope picture on screens, such as a personal computer, in work
[Claim 4] the exposure condition determination support method characterized by supporting condition determination by [which determine the focus in an aligner, and the optimal exposure conditions of light exposure] carrying out condition appearance, making a focus and the measurement point correspond, and putting in order and displaying a size value and a pattern judging as a microscope picture on screens, such as a personal computer, in work
[Claim 5] the exposure condition determination support method characterized by supporting condition determination by [which determine the focus in an aligner, and the optimal exposure conditions of light exposure] carrying out condition appearance, making light exposure and the measurement point correspond, and putting in order and displaying a size value and a pattern judging as a microscope picture on screens, such as a personal computer, in work
[Claim 6] the exposure condition determination support method characterized by supporting condition determination by [which determine the focus in an aligner, and the optimal exposure conditions of light exposure] carrying out condition appearance and displaying the focal dependency graph of a size, and a light exposure dependency graph on screens, such as a personal computer, in work
[Claim 7] Claims 1, 3, 4, 5, and 6 are exposure condition determination support equipment using the method of a publication either.
[Claim 8] Claims 3, 4, 5, and 6 are microscope equipment which has the function of a publication either.
[Claim 9] The exposure condition determination support method characterized by providing the

following. The 1st step which performs exposure processing on exposure conditions which are different to two or more unit exposure fields. The 2nd step which observes and evaluates the imprint pattern obtained to each aforementioned unit exposure field by the aforementioned exposure processing, and is recorded as an evaluation result, and the 3rd step which determines the optimal range of the aforementioned exposure conditions based on the aforementioned evaluation result in each of two or more aforementioned unit exposure fields.
[Claim 10] The exposure condition determination support method of carrying out exposing a pattern which classifies the inside of each aforementioned unit exposure field into two or more pattern spaces, and is different for each aforementioned pattern space of every at the 1st step of the above in the exposure condition determination support method according to claim 9, and the 2nd step of the above estimating the aforementioned imprint pattern for every aforementioned pattern space in each aforementioned unit exposure field, and recording as the aforementioned evaluation result as the feature.
[Claim 11] In the exposure condition determination support method according to claim 9 at the 3rd step of the above Based on the aforementioned evaluation result of the aforementioned imprint pattern, the optimal range of the aforementioned exposure conditions is determined for every aforementioned pattern space with which two or more aforementioned unit exposure fields correspond. Furthermore, the exposure condition determination support method characterized by determining the field of the aforementioned exposure conditions that the aforementioned optimal ranges acquired for every aforementioned pattern space overlap as the final optimal range of the aforementioned exposure conditions.
[Claim 12] with a means to record the evaluation result of the imprint pattern obtained by the exposure processing by the aforementioned exposure conditions of determining the optimal range of the exposure conditions in an aligner and that are exposure condition determination support equipment which carries out condition appearance and supports work, and plurality differs Exposure condition determination support equipment characterized by including a means to determine the optimal range of the aforementioned exposure conditions automatically based on the aforementioned evaluation result in each of two or more unit exposure fields.
[Claim 13] In each of the exposure processing by the aforementioned exposure conditions that plurality differs in exposure condition determination support equipment according to claim 12 They are collectively exposed by two or more sorts of different aforementioned imprint patterns. for each aforementioned imprint pattern of every Exposure condition determination support equipment characterized by determining the field of the aforementioned exposure conditions that the aforementioned optimal ranges which the aforementioned evaluation result was recorded and were acquired for every aforementioned imprint pattern overlap as the final aforementioned optimal range of the aforementioned exposure conditions.
[Claim 14] The manufacture method of the semiconductor device which is the manufacture method of the semiconductor device which forms a semiconductor device in the aforementioned semiconductor wafer by imprinting a pattern to a semiconductor wafer in a photolithography, and is characterized by determining the optimal exposure conditions in the aforementioned photolithography using claims 1, 3, 4, 5, 6, 9, and 10, the exposure condition determination support method of 11 publications or claims 2, 7, and 12, and the exposure condition determination support equipment of 13 publications.

[Translation done.]

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] in case this invention relates to the manufacturing technology which uses an aligner and construction work is especially started for a product, the focus set as an aligner and the optimum conditions of light exposure are determined -- it is related for carrying out condition appearance
[0002]
[Description of the Prior Art] In the case of the photolithography process in semiconductor manufacture, the focus at the time of printing a pattern by the aligner, and the optimum conditions of light exposure The wafer which changed a focus and light exposure into 1 time of every exposure unit (shot), and printed the pattern on it is made. with microscope equipment the size of the pattern of two or more arbitrary points of the wafer is measured, or resolving (result) of a pattern is observed, and the focus in which the optimal pattern is formed, and light exposure are found -- condition appearance was carried out and work has determined
[0003] Conventionally, experts, such as a special engineer, are doing this work, data, such as a judgment of the result (resolving) of the measured size and a pattern and a measurement place, are recorded on paper, and the photograph is taken with the video printer if needed. later The care force of the data was carried out to the personal computer, they were arranged in the office etc., the size property graph was created, the photograph was put in order and stuck on paper, change of a pattern was seen, and the optimum conditions of a focus and light exposure are determined in consideration of various factors.

[0004] An example of the form which records measurement data on drawing 9 is shown. before it works by carrying out condition appearance, this record form fills in the range of the shot which exists in the wafer used for carrying out condition appearance, and the focus to set up and light exposure are entered in corresponding train and line, and it makes them And it has this record form, the pattern of the arbitrary points in a shot is measured with microscope equipment, and it is recording on the size value and the point with which the pattern judging was measured in the rectangular head of the position of a corresponding shot by handwriting. Moreover, the coordinate in the measured shot is also recorded on the place of a margin. At this time, two or more points measured and observed are the same places in every shot.
[0005] Moreover, since the photograph looks at what photograph it is later and understands it in case a photograph is taken, information, such as a focus and light exposure, is recorded on the photograph. Furthermore, it is collecting, considering how a photograph is arranged at this time.
[0006]
[Problem(s) to be Solved by the Invention] Collection of data and a photograph and arrangement took

time and effort very much, and the above conventional methods have taken time. Especially at collection, record in a photograph has taken time and effort, and the work which puts in order the photograph which inputs into the personal computer in an office the data recorded on the record form, and which were worked and collected, and is stuck on paper, and work serious [both] take time by arrangement.

[0007] In addition, time greater as this work has many amounts of the data to collect and photographs is required, and it becomes so late to determine optimum conditions. For example, when it is necessary to observe minutely the time of starting of a new aligner, and development and a trial production of a new product etc. and conditions need to be searched for, in order to observe as many points as possible and to collect data and photographs, the arrangement and analysis take a long time.

[0008] On the contrary, on a certain point, when improving the conditions determined the time of being in a hurry, and at once several days after when it is not necessary to ask minutely for example, in order to perform only the judgment of a pattern, without measuring a size, or not to acquire a photograph, or to thin out and to collect data and photographs, working hours become short. However, the judgment may be wrong and conditions may be determined only by record of a judgment of a pattern based on the data which confirmed and made a mistake in the truth as it is the poor pattern which was judged to be a normal pattern in fact.

[0009] in addition, there are various cases for carrying out condition appearance, and its working hours also differ from data and photograph collection, and arrangement, respectively Moreover, when the record form is improved later, there is what the content of record does not understand anymore by him who worked, either.

[0010] Furthermore, by the above conventional methods, since it is determined depending on the subjectivity of operators, such as an engineer, or experience, the determined conditions may have shifted from the really optimal conditions. Moreover, since the decision criterion of optimum conditions changes with engineers, the gap between engineers arises.

[0011] Moreover, arrangement of data took time and effort very much, and time is required. In addition, the more this work has many amounts of the data to collect, time will be required and, the more time until it determines optimum conditions becomes this thing. For example, since as many points as possible are observed and collection of data is needed when it is necessary to observe minutely the time of starting of a new aligner, and development and a trial production of a new product etc. and conditions need to be searched for, collection not only takes time, but arrangement takes time so much.

[0012] The purpose of this invention is to offer the method of supporting the determination of exposure conditions which can collect many data and photographs easily, and can arrange data and a photograph in short time, without being influenced by the amount, and the equipment using it.

[0013] Other purposes of this invention are to offer the exposure condition determination technology of determining exposure conditions correctly without carrying out data reduction in short time and being dependent on the subjectivity of operators, such as an engineer, or experience, without being influenced by the amount of collected data.

[0014] other purposes of this invention -- the manufacturing process of a semiconductor device -- setting -- condition appearance -- carrying out -- etc. -- it is in offering the manufacturing technology of the semiconductor device which can raise the throughput of the whole process including the preparatory work

[0015] Other purposes of this invention are in the manufacturing process of a semiconductor device to offer the manufacturing technology of the semiconductor device which can raise the yield in an exposure process by determination of the exposure conditions in an objective and exact exposure process.

[0016] The other purposes and the new feature will become clear from description and the

accompanying drawing of this specification at the aforementioned row of this invention.
[0017]
[Means for Solving the Problem] It will be as follows if the outline of a typical thing is briefly explained among invention indicated in this application.
[0018] The yes-no decision of the size which measured the above-mentioned purpose with microscope equipment, and the observed pattern, and its picture, Online collection of the information on wafers, such as a form, a process, and exposure conditions, is carried out through a network. A size, a judgment, and a picture, Make a form, a process, and exposure conditions link, and it saves at storages, such as a server. The information saved with the personal computer installed in the manufacture site, the office, etc. at storages, such as a server, is read, and it is attained processing the information and displaying a picture side by side on a screen, and by displaying a size property graph. The collection working hours of a photograph are shortened by this and the work of data reduction, such as a size, and arrangement of a photograph becomes unnecessary by it.
[0019] Moreover, the 1st step which performs exposure processing on the exposure conditions from which this invention differs to two or more unit exposure fields as the exposure condition determination support method, The imprint pattern obtained to each unit exposure field by exposure processing is observed and evaluated, and the 2nd step recorded as an evaluation result and the 3rd step which determines the optimal range of exposure conditions based on the evaluation result in each of two or more unit exposure fields are performed.
[0020] Moreover, this invention is set to the exposure condition determination support equipment which determines the optimal range of the exposure conditions in an aligner and which carries out condition appearance and supports work. It has a means to record the evaluation result of the imprint pattern obtained by the exposure processing by the exposure conditions from which plurality differs, and a means to determine the optimal range of exposure conditions automatically based on the evaluation result in each of two or more unit exposure fields.
[0021]
[Embodiments of the Invention] Hereafter, the gestalt of operation of the exposure condition determination method in the exposure process in the manufacturing process of the semiconductor device by this invention and equipment is explained in detail with reference to a drawing.
[0022] (Gestalt 1 of operation) Drawing 1 shows the outline of the method of supporting the determination of the optimal exposure conditions by this invention, and its equipment. This equipment consists of a manufacture site PC 10 which searches the database 9 which saves the server 8 which collects the microscope equipments 4, such as the aligner 1 which prints a pattern on a wafer, and the length measurement SEM (scanning electron microscope) which measures a size, a measurement result, and pictures, and its information, a measurement result, and a picture from a database 9, and displays and prints them, and an office PC 11. First, a focus and light exposure are changed every shot 3 of a wafer 2 by the aligner 1, and an exposure pattern (the example of drawing circle 68) is printed. Next, the microscope picture 6 projected on Screen 5 with the microscope equipments 4, such as length measurement SEM, is seen, the size of arbitrary exposure patterns (the example of drawing circle 68) is measured, the state of the above-mentioned pattern is observed, the judgment is inputted, and the measurement information 7, such as a place of a picture and its picture, and a size, a judgment, is saved. Wafer information, such as a form, a process, a focus, and light exposure, is also saved simultaneously. A judgment input means for this and a picture preservation means are provided to microscope equipment 4. And the saved picture, and measurement information and wafer information are transmitted to a server 8 through a network 69, and is saved in a database 9. A picture, measurement information, and exposure conditions are made to link to a database 9, and it saves in it.

[0023] And the measurement result and picture which were saved in the database 9 in the manufacture site PC 10 and the office PC 11 are searched, as the photograph was conventionally stuck on paper in the handicraft, the picture list 12 is displayed or the graph of the focal dependency 13 and the light exposure dependency 14 is displayed. Moreover, printing of the picture list 12, the focal dependency 13, and the light exposure dependency 14 is also enabled. Thereby, arrangement of a measurement result and a picture can make time and effort there be nothing. In addition, if it installs near the microscope equipment 4, the manufacture site PC 10 finishes work with microscope equipment 4, and can check change of a measurement result and a pattern on that spot immediately.

[0024] Drawing 2 displays the index information 15, such as the form and process which the screen which displayed the picture, and the size and the judgment which are the gestalt of 1 operation of this invention side by side on the list of the shot on a wafer is shown, and show of what condition **** they are data and a picture, and an aligner, and arranges the focal value 16 and light exposure 17 in on a screen according to the direction changed, respectively. And the size value 19 and the pattern judging 20 are displayed as the focal value 16 and picture 18 corresponding to the matrix top of light exposure 17. Although it is made to display by three shots long and the five shots wide matrix in drawing 2 , it is good in lists arbitrary in the range which can be displayed. The case where the picture 18 of all conditions, the size value 19, and the pattern judging 20 cannot be displayed on a screen is considered, a scrolling button is arranged, and it enables it to see all the pictures 18, the size value 19, and the pattern judging 20 by clicking this button with a mouse here. It scrolls on the left-hand side of 1 data by clicking the left 1 data scrolling button 21, it scrolls on left-hand side by 1 page by clicking the left 1 page scrolling button 22, and a picture 18, the size value 19, and the pattern judging 20 are displayed. Similarly, it scrolls, respectively with the right 1 data scrolling button 23, the right 1 page scrolling button 24, the upper 1 data scrolling button 25, the upper 1 page scrolling button 26, the lower 1 data scrolling button 27, and the lower 1 page scrolling button 28. Moreover, it understands whether it is that to which the list displayed now measured where by displaying measurement point No. The picture 18 to display, the size value 19, and the measurement point of the pattern judging 20 are changed, and it enables it to change a display like scrolling of a screen also here with the change-under the measurement point button 29, and the change-on the measurement point button 30.

[0025] Moreover, since the number of the pictures which can be displayed at once by one shot is one, when the picture of two or more sheets is being photographed in the same place, they cannot be displayed simultaneously. Then, when the portion of a picture 18 is clicked with a mouse, a picture is made to be turned over one by one. For example, they are the case where a picture is retaken, and the case where a scale factor is changed and photographed.

[0026] Since change of how to be able to do a pattern can be grasped by this display, it comes to turn out where exposure conditions should be carried out at a glance.

[0027] Moreover, if the printing button 31 is clicked, it is also possible to print this screen by the printer as it is. Moreover, arbitrary additional information can also be inputted into the comment input field 32.

[0028] Moreover, when pattern judging 7a of the microscope picture 6 performed with microscope equipment 4 is wrong, it is also possible to change pattern judging 7a on this screen.

[0029] Drawing 3 displays the index information 15 which shows of what condition **** they are data and a picture like the screen which shows the screen which put in order and displayed the picture, and the size and the judgment which are the gestalt of 1 operation of this invention on the measurement point to the focus, and was shown in drawing 2 , arranges the focal value 16 in lengthwise, arranges the measurement point 33 in a longitudinal direction, and makes a matrix. And the size value 19 and the pattern judging 20 are displayed as the focal value 16 and picture 18 corresponding to the matrix top of the measurement point 33.

[0030] Although it is made to display by vertical 3 focus and the five points wide matrix in drawing 3 . it is good in lists arbitrary in the range which can be displayed. The case where pictures 18 and the size values 19. and no pattern judgings 20 can be displayed on a screen is considered like the screen shown in drawing 2 . a scrolling button is arranged. and it enables it to see all the pictures 18. the size value 19. and the pattern judging 20 by clicking this button with a mouse also in this screen.
[0031] moreover. the list displayed by displaying light exposure now -- light exposure -- it understands how many things they are The light exposure of the list to display is changed and it enables it to change a display like scrolling of a screen also here with the change-under light exposure button 34. and the change-on light exposure button 35. This display comes to show at a glance whether the pattern of all the measurement points is formed correctly. if it is made which focus.
[0032] Drawing 4 displays the index information 15 which shows of what condition **** they are data and a picture like the screen which shows the screen which put in order and displayed the picture. and the size and the judgment which are the gestalt of 1 operation of this invention on the measurement point to light exposure. and was shown in drawing 2 and drawing 3 . arranges light exposure 17 in lengthwise. arranges the measurement point 33 in a longitudinal direction. and makes a matrix. And the size value 19 and the pattern judging 20 are displayed as the light exposure 17 and picture 18 corresponding to the matrix top of the measurement point 33. Although it is made to display by vertical 3 focus and the five points wide matrix in drawing 4 . it is good in lists arbitrary in the range which can be displayed.
[0033] The case where pictures 18 and the size values 19. and no pattern judgings 20 can be displayed on a screen is considered like the screen shown in drawing 2 and drawing 3 also in this screen. a scrolling button is arranged. and it enables it to see all the pictures 18. the size value 19. and the pattern judging 20 by clicking this button with a mouse. moreover. the list displayed by displaying a focal value now -- a focus -- it understands how many things they are The focus of the list to display is changed and it enables it to change a display like scrolling of a screen also here with the change-under focus button 36. and the change-on focus button 37. This display comes to show at a glance whether the pattern of all the measurement points is formed correctly. if it is made which light exposure.
[0034] The details of drawing 5 of the pattern which does not appear clearly can come to be seen by the picture list which shows the screen which carried out the enlarged display of the picture which is the gestalt of 1 operation of this invention. and was shown in drawing 2 . drawing 3 . and drawing 4 clearly with the expansion picture 38. It is displayed that this screen chooses the picture [is the screen shown in drawing 2 . drawing 3 . and drawing 4 . and] 18 to carry out an enlarged display. The selection means of a picture 18 has a means to double-click the left button of a mouse. Or you may specify an image file name from the image file name input field 40. Here. the result judged at once can be changed by clicking the judgment field 41 with a mouse. It is also possible to be able to correct. when the judged result is wrong. not to judge with microscope equipment. to collect only a size and pictures. and to perform a judgment in a personal computer by this. depending on the case.
[0035] Moreover. a picture and the incidental information 39 are saved by clicking the preservation button 42 with a mouse at the hard disk of a personal computer etc. An operator can create arbitrary data etc. using this saved picture and the incidental information 39. This picture can be used also for another data. Moreover. printing is also possible by clicking the printing button 43 with a mouse.
[0036] Drawing 6 is what shows the screen which displayed the picture side by side according to the measurement point in a shot. When a certain shot. i.e.. exposure conditions. is chosen. in the shot Very much the picture photographed at the lower left. Nakashita. and the lower right among the right among the upper left. Nakagami. the upper right. and the left Respectively in the position of the shot

upper left picture 44, the shot Nakagami picture 45, the shot upper right picture 46, the picture 47 in the shot left, the picture 48 in the inside of a shot, the picture 49 in the shot right, the shot lower left picture 50, the shot Nakashita picture 51, and the shot lower right picture 52 The coordinate 53 in the shot of each measurement point is displayed on the bottom of a picture. It is the display for finding that how for this [whose] to be the performance of the lens of an aligner 1 and able to do a pattern in the center of a shot and the direction of an edge is different depending on exposure conditions. This display is effective in finding the exposure conditions in which a normal pattern is formed throughout the inside of a shot. Moreover, the related incidental information 54 is also outputted to a screen. Moreover, printing is also possible by clicking the printing button 55 with a mouse.

[0037] Drawing 7 shows the focal dependency in a certain measurement point (measurement pattern), and adds the specification value 61 of a size, and the specification value minimum 62, the specification value upper limit 63, the focal lower limit 64 that can form a normal pattern and the focal upper limit 65 to a graph. With this graph, change of a size becomes quite obvious, and as compared with the specification value of the measured pattern, if the optimal focus and the optimal it are which range, it can judge easily whether it is good.

[0038] Drawing 8 shows the light exposure dependency in a certain measurement point (measurement pattern), and adds the specification value 61 of a size, and the specification value minimum 62, the specification value upper limit 63, the light exposure lower limit 66 that can form a normal pattern and the light exposure upper limit 67 to a graph. With this graph, change of a size becomes quite obvious, and as compared with the specification value of the measured pattern, if the optimal light exposure and the optimal it are which range, it can judge easily whether it is good.

[0039] (Gestalt 2 of operation) Drawing 10 is the functional block diagram showing an example of the composition of exposure condition determination equipment which enforces the exposure condition determination method which is the gestalt of other operations of this invention, and the conceptual diagram drawing 11 , drawing 12 and drawing 13 , drawing 14 , and drawing 15 explain an example of the operation to be, and drawing 16 are the flow charts explaining an example of the operation.

[0040] The exposure condition determination equipment of the gestalt of this operation consists of a measurement / observation data preservation means 102 to save a measurement / observation means 101 to observe measurement and resolving for the size of a WEPA turn, size data, and the quality data of resolving, a condition calculation means 103 to compute the optimal conditions, and a condition display means 104 to display the computed conditions.

[0041] In addition, since the hardware composition of the gestalt of this operation can use each composition illustrated in the gestalt 1 of the above-mentioned operation, it quotes the composition of the gestalt 1 of operation using a corresponding sign if needed.

[0042] That is, each of these meanses are the following correspondence relations, and the composition illustrated in the gestalt 1 of the above-mentioned operation can be used for them.

[0043] For example, measurement / observation means 101 is realizable using the microscope equipments 4, such as length measurement SEM. Measurement / observation data preservation means 102 is realizable using a database 9. The condition calculation means 103 is realizable as software mounted in the server 8. The condition display means 104 is realizable using the manufacture site PC 10 and an office PC 11.

[0044] First, size measurement of arbitrary patterns and resolving are observed for the wafer which changed a focus and light exposure into every exposure unit (shot 3 of a wafer 2) using the aligner 1, and burned the pattern with measurement / observation means 101, and a quality is judged. And the information measured and judged here is saved for measurement / observation data preservation means 102 at any time. At this time, if the quality judging of resolving is good and it is useless in O, it saves x. And the condition calculation means 103 is beginning to read saved measurement /

observation data, and performs calculation processing. And the computed exposure conditions are expressed as the condition display means 104.

[0045] Drawing 11 shows an example of record of measurement observation data obtained by measurement observation means 101. The rectangular head surrounded as one solid line expresses the exposure unit 105 (shot), nine kinds of different focal conditions of 0# - 8# are set up in the direction of a horizontal axis, and nine kinds of different light exposure conditions of 0# - 8# are further set up in the direction of a vertical axis. although the serration of these focal conditions and light exposure conditions is based on the resist to be used -- as an example -- focal conditions -- for example, 0.1 micrometers - 0.2 micrometers -- cutting fine -- light exposure conditions -- 200-400J/m2 It cuts fine and comes out.

[0046] Moreover, the small rectangular head divided by the dotted line in each exposure unit 105 expresses the column which records the data of each pattern. This column turns into the column 106 of a pattern P1, the column 107 of a pattern P2, the column 108 of a pattern P3, the column 109 of a pattern P4, the column 110 of pattern P5, and the column 111 of a pattern P6 from the upper left.

[0047] For example, a pattern P1 expresses the line & space where a pattern P3 is parallel to the direction of Y for the line & space where a pattern P2 is parallel to the direction of X of the direction of X-Y of the wafer stage of an aligner 1, and a pattern P4 expresses each imprint pattern and its observation result of line & space ** of the direction of slant for a hole pattern.

[0048] Even if there are more patterns measured and observed in this example although record to six kinds of patterns is possible in one exposure unit 105 than it, they are good at least. The these-collected data are related with a focus and light exposure, are carried out, and are saved for measurement / observation data preservation means 102.

[0049] Drawing 12 shows how to compute the optimal exposure conditions. the shaft of two-dimensional system of coordinates -- a focus and light exposure -- taking -- the system of coordinates -- patterns P1-P6 -- respectively -- ** -- it is alike and a size and resolving describe the good range At this time, as for the point used as a boundary, a size and a judgment describe the range with the circle of the approximation at O which considers as outside conditions most and surrounds it for a point inside to the shaft of a focus and light exposure.

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TECHNICAL FIELD

[The technical field to which invention belongs] in case this invention relates to the manufacturing technology which uses an aligner and construction work is especially started for a product, the focus set as an aligner and the optimum conditions of light exposure are determined -- it is related for carrying out condition appearance
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PRIOR ART

[Description of the Prior Art] In the case of the photolithography process in semiconductor manufacture, the focus at the time of printing a pattern by the aligner, and the optimum conditions of light exposure The wafer which changed a focus and light exposure into 1 time of every exposure unit (shot), and printed the pattern on it is made. with microscope equipment the size of the pattern of two or more arbitrary points of the wafer is measured, or resolving (result) of a pattern is observed, and the focus in which the optimal pattern is formed, and light exposure are found -- condition appearance was carried out and work has determined
[0003] Conventionally, experts, such as a special engineer, are doing this work, data, such as a judgment of the result (resolving) of the measured size and a pattern and a measurement place, are recorded on paper, and the photograph is taken with the video printer if needed. later The care force of the data was carried out to the personal computer, they were arranged in the office etc., the size property graph was created, the photograph was put in order and stuck on paper, change of a pattern was seen, and the optimum conditions of a focus and light exposure are determined in consideration of various factors.
[0004] An example of the form which records measurement data on drawing 9 is shown. before it works by carrying out condition appearance, this record form fills in the range of the shot which exists in the wafer used for carrying out condition appearance, and the focus to set up and light exposure are entered in corresponding train and line, and it makes them And it has this record form, the pattern of the arbitrary points in a shot is measured with microscope equipment, and it is recording on the size value and the point with which the pattern judging was measured in the rectangular head of the position of a corresponding shot by handwriting. Moreover, the coordinate in the measured shot is also recorded on the place of a margin. At this time, two or more points measured and observed are the same places in every shot.
[0005] Moreover, since the photograph looks at what photograph it is later and understands it in case a photograph is taken, information, such as a focus and light exposure, is recorded on the photograph. Furthermore, it is collecting, considering how a photograph is arranged at this time.

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EFFECT OF THE INVENTION

[Effect of the Invention] It will be as follows if the effect acquired by the typical thing among invention indicated in this application is explained briefly.

[0069] According to this invention, many data and photographs can be collected easily, and the method of supporting the determination of exposure conditions which can arrange data and a photograph in short time, and the equipment using it can be offered, without being influenced by the amount.

[0070] Moreover, the effect that exposure conditions can be correctly determined without according to this invention carrying out data reduction in short time and being dependent on the subjectivity of operators, such as an engineer, or experience, without being influenced by the amount of collected data is acquired.

[0071] moreover -- according to this invention -- the manufacturing process of a semiconductor device -- setting -- condition appearance -- carrying out -- etc. -- the effect that the throughput of the whole process including the preparatory work can be raised is acquired

[0072] Moreover, according to this invention, in the manufacturing process of a semiconductor device, the effect that the yield in an exposure process can be raised by determination of the exposure conditions in an objective and exact exposure process is acquired.

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TECHNICAL PROBLEM

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[0007] In addition, time greater as this work has many amounts of the data to collect and photographs is required, and it becomes so late to determine optimum conditions. For example, when it is necessary to observe minutely the time of starting of a new aligner, and development and a trial production of a new product etc. and conditions need to be searched for, in order to observe as many points as possible and to collect data and photographs, the arrangement and analysis take a long time.
[0008] On the contrary, on a certain point, when improving the conditions determined the time of being in a hurry, and at once several days after when it is not necessary to ask minutely for example, in order to perform only the judgment of a pattern, without measuring a size, or not to acquire a photograph, or to thin out and to collect data and photographs, working hours become short. However, the judgment may be wrong and conditions may be determined only by record of a judgment of a pattern based on the data which confirmed and made a mistake in the truth as it is the poor pattern which was judged to be a normal pattern in fact.
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[0010] Furthermore, by the above conventional methods, since it is determined depending on the subjectivity of operators, such as an engineer, or experience, the determined conditions may have shifted from the really optimal conditions. Moreover, since the decision criterion of optimum conditions changes with engineers, the gap between engineers arises.
[0011] Moreover, arrangement of data took time and effort very much, and time is required. In addition, the more this work has many amounts of the data to collect, time will be required and, the more time until it determines optimum conditions becomes this thing. For example, since as many points as possible are observed and collection of data is needed when it is necessary to observe minutely the time of starting of a new aligner, and development and a trial production of a new product etc. and conditions need to be searched for, collection not only takes time, but arrangement takes time so much.
[0012] The purpose of this invention is to offer the method of supporting the determination of exposure conditions which can collect many data and photographs easily, and can arrange data and a photograph in short time, without being influenced by the amount, and the equipment using it.

[0013] Other purposes of this invention are to offer the exposure condition determination technology of determining exposure conditions correctly without carrying out data reduction in short time and being dependent on the subjectivity of operators, such as an engineer, or experience, without being influenced by the amount of collected data.
[0014] other purposes of this invention -- the manufacturing process of a semiconductor device -- setting -- condition appearance -- carrying out -- etc. -- it is in offering the manufacturing technology of the semiconductor device which can raise the throughput of the whole process including the preparatory work
[0015] Other purposes of this invention are in the manufacturing process of a semiconductor device to offer the manufacturing technology of the semiconductor device which can raise the yield in an exposure process by determination of the exposure conditions in an objective and exact exposure process.
[0016] The other purposes and the new feature will become clear from description and the accompanying drawing of this specification at the aforementioned row of this invention.

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MEANS

[Means for Solving the Problem] It will be as follows if the outline of a typical thing is briefly explained among invention indicated in this application.
[0018] The yes-no decision of the size which measured the above-mentioned purpose with microscope equipment, and the observed pattern, and its picture. Online collection of the information on wafers, such as a form, a process, and exposure conditions, is carried out through a network. A size, a judgment, and a picture. Make a form, a process, and exposure conditions link, and it saves at storages, such as a server. The information saved with the personal computer installed in the manufacture site, the office, etc. at storages, such as a server, is read, and it is attained processing the information and displaying a picture side by side on a screen, and by displaying a size property graph. The collection working hours of a photograph are shortened by this and the work of data reduction, such as a size, and arrangement of a photograph becomes unnecessary by it.
[0019] Moreover, the 1st step which performs exposure processing on the exposure conditions from which this invention differs to two or more unit exposure fields as the exposure condition determination support method. The imprint pattern obtained to each unit exposure field by exposure processing is observed and evaluated, and the 2nd step recorded as an evaluation result and the 3rd step which determines the optimal range of exposure conditions based on the evaluation result in each of two or more unit exposure fields are performed.
[0020] Moreover, this invention is set to the exposure condition determination support equipment which determines the optimal range of the exposure conditions in an aligner and which carries out condition appearance and supports work. It has a means to record the evaluation result of the imprint pattern obtained by the exposure processing by the exposure conditions from which plurality differs, and a means to determine the optimal range of exposure conditions automatically based on the evaluation result in each of two or more unit exposure fields.
[0021]
[Embodiments of the Invention] Hereafter, the gestalt of operation of the exposure condition determination method in the exposure process in the manufacturing process of the semiconductor device by this invention and equipment is explained in detail with reference to a drawing.
[0022] (Gestalt 1 of operation) Drawing 1 shows the outline of the method of supporting the determination of the optimal exposure conditions by this invention, and its equipment. This equipment consists of a manufacture site PC 10 which searches the database 9 which saves the server 8 which collects the microscope equipments 4, such as the aligner 1 which prints a pattern on a wafer, and the length measurement SEM (scanning electron microscope) which measures a size, a measurement result, and pictures, and its information, a measurement result, and a picture from a database 9, and displays and prints them, and an office PC 11. First, a focus and light exposure are changed every shot 3 of a wafer 2 by the aligner 1, and an exposure pattern (the example of drawing

circle 68) is printed. Next, the microscope picture 6 projected on Screen 5 with the microscope equipments 4, such as length measurement SEM, is seen, the size of arbitrary exposure patterns (the example of drawing circle 68) is measured, the state of the above-mentioned pattern is observed, the judgment is inputted, and the measurement information 7, such as a place of a picture and its picture, and a size, a judgment, is saved. Wafer information, such as a form, a process, a focus, and light exposure, is also saved simultaneously. A judgment input means for this and a picture preservation means are provided to microscope equipment 4. And the saved picture, and measurement information and wafer information are transmitted to a server 8 through a network 69, and is saved in a database 9. A picture, measurement information, and exposure conditions are made to link to a database 9, and it saves in it.

[0023] And the measurement result and picture which were saved in the database 9 in the manufacture site PC 10 and the office PC 11 are searched, as the photograph was conventionally stuck on paper in the handicraft, the picture list 12 is displayed or the graph of the focal dependency 13 and the light exposure dependency 14 is displayed. Moreover, printing of the picture list 12, the focal dependency 13, and the light exposure dependency 14 is also enabled. Thereby, arrangement of a measurement result and a picture can make time and effort there be nothing. In addition, if it installs near the microscope equipment 4, the manufacture site PC 10 finishes work with microscope equipment 4, and can check change of a measurement result and a pattern on that spot immediately.

[0024] Drawing 2 displays the index information 15, such as the form and process which the screen which displayed the picture, and the size and the judgment which are the gestalt of 1 operation of this invention side by side on the list of the shot on a wafer is shown, and show of what condition **** they are data and a picture, and an aligner, and arranges the focal value 16 and light exposure 17 in on a screen according to the direction changed, respectively. And the size value 19 and the pattern judging 20 are displayed as the focal value 16 and picture 18 corresponding to the matrix top of light exposure 17. Although it is made to display by three shots long and the five shots wide matrix in drawing 2 , it is good in lists arbitrary in the range which can be displayed. The case where the picture 18 of all conditions, the size value 19, and the pattern judging 20 cannot be displayed on a screen is considered, a scrolling button is arranged, and it enables it to see all the pictures 18, the size value 19, and the pattern judging 20 by clicking this button with a mouse here. It scrolls on the left-hand side of 1 data by clicking the left 1 data scrolling button 21, it scrolls on left-hand side by 1 page by clicking the left 1 page scrolling button 22, and a picture 18, the size value 19, and the pattern judging 20 are displayed. Similarly, it scrolls, respectively with the right 1 data scrolling button 23, the right 1 page scrolling button 24, the upper 1 data scrolling button 25, the upper 1 page scrolling button 26, the lower 1 data scrolling button 27, and the lower 1 page scrolling button 28. Moreover, it understands whether it is that to which the list displayed now measured where by displaying measurement point No. The picture 18 to display, the size value 19, and the measurement point of the pattern judging 20 are changed, and it enables it to change a display like scrolling of a screen also here with the change-under the measurement point button 29, and the change-on the measurement point button 30.

[0025] Moreover, since the number of the pictures which can be displayed at once by one shot is one, when the picture of two or more sheets is being photographed in the same place, they cannot be displayed simultaneously. Then, when the portion of a picture 18 is clicked with a mouse, a picture is made to be turned over one by one. For example, they are the case where a picture is retaken, and the case where a scale factor is changed and photographed.

[0026] Since change of how to be able to do a pattern can be grasped by this display, it comes to turn out where exposure conditions should be carried out at a glance.

[0027] Moreover, if the printing button 31 is clicked, it is also possible to print this screen by the printer as it is. Moreover, arbitrary additional information can also be inputted into the comment input field 32.

[0028] Moreover, when pattern judging 7a of the microscope picture 6 performed with microscope equipment 4 is wrong, it is also possible to change pattern judging 7a on this screen.

[0029] Drawing 3 displays the index information 15 which shows of what condition **** they are data and a picture like the screen which shows the screen which put in order and displayed the picture, and the size and the judgment which are the gestalt of 1 operation of this invention on the measurement point to the focus, and was shown in drawing 2 , arranges the focal value 16 in lengthwise, arranges the measurement point 33 in a longitudinal direction, and makes a matrix. And the size value 19 and the pattern judging 20 are displayed as the focal value 16 and picture 18 corresponding to the matrix top of the measurement point 33.

[0030] Although it is made to display by vertical 3 focus and the five points wide matrix in drawing 3 , it is good in lists arbitrary in the range which can be displayed. The case where pictures 18 and the size values 19, and no pattern judgings 20 can be displayed on a screen is considered like the screen shown in drawing 2 , a scrolling button is arranged, and it enables it to see all the pictures 18, the size value 19, and the pattern judging 20 by clicking this button with a mouse also in this screen.

[0031] moreover, the list displayed by displaying light exposure now -- light exposure -- it understands how many things they are The light exposure of the list to display is changed and it enables it to change a display like scrolling of a screen also here with the change-under light exposure button 34, and the change-on light exposure button 35. This display comes to show at a glance whether the pattern of all the measurement points is formed correctly, if it is made which focus.

[0032] Drawing 4 displays the index information 15 which shows of what condition **** they are data and a picture like the screen which shows the screen which put in order and displayed the picture, and the size and the judgment which are the gestalt of 1 operation of this invention on the measurement point to light exposure, and was shown in drawing 2 and drawing 3 , arranges light exposure 17 in lengthwise, arranges the measurement point 33 in a longitudinal direction, and makes a matrix. And the size value 19 and the pattern judging 20 are displayed as the light exposure 17 and picture 18 corresponding to the matrix top of the measurement point 33. Although it is made to display by vertical 3 focus and the five points wide matrix in drawing 4 , it is good in lists arbitrary in the range which can be displayed.

[0033] The case where pictures 18 and the size values 19, and no pattern judgings 20 can be displayed on a screen is considered like the screen shown in drawing 2 and drawing 3 also in this screen, a scrolling button is arranged, and it enables it to see all the pictures 18, the size value 19, and the pattern judging 20 by clicking this button with a mouse. moreover, the list displayed by displaying a focal value now -- a focus -- it understands how many things they are The focus of the list to display is changed and it enables it to change a display like scrolling of a screen also here with the change-under focus button 36, and the change-on focus button 37. This display comes to show at a glance whether the pattern of all the measurement points is formed correctly, if it is made which light exposure.

[0034] The details of drawing 5 of the pattern which does not appear clearly can come to be seen by the picture list which shows the screen which carried out the enlarged display of the picture which is the gestalt of 1 operation of this invention, and was shown in drawing 2 , drawing 3 , and drawing 4 clearly with the expansion picture 38. It is displayed that this screen chooses the picture [is the screen shown in drawing 2 , drawing 3 , and drawing 4 , and] 18 to carry out an enlarged display. The selection means of a picture 18 has a means to double-click the left button of a mouse. Or you may specify an image file name from the image file name input field 40. Here, the result judged at once can be changed by clicking the judgment field 41 with a mouse. It is also possible to be able to correct, when the judged result is wrong, not to judge with microscope equipment, to collect only a size and pictures, and to perform a judgment in a personal computer by this, depending on the case.

[0035] Moreover, a picture and the incidental information 39 are saved by clicking the preservation button 42 with a mouse at the hard disk of a personal computer etc. An operator can create arbitrary data etc. using this saved picture and the incidental information 39. This picture can be used also for another data. Moreover, printing is also possible by clicking the printing button 43 with a mouse.

[0036] Drawing 6 is what shows the screen which displayed the picture side by side according to the measurement point in a shot. When a certain shot, i.e., exposure conditions, is chosen, in the shot Very much the picture photographed at the lower left, Nakashita, and the lower right among the right among the upper left, Nakagami, the upper right, and the left Respectively in the position of the shot upper left picture 44, the shot Nakagami picture 45, the shot upper right picture 46, the picture 47 in the shot left, the picture 48 in the inside of a shot, the picture 49 in the shot right, the shot lower left picture 50, the shot Nakashita picture 51, and the shot lower right picture 52 The coordinate 53 in the shot of each measurement point is displayed on the bottom of a picture. It is the display for finding that how for this [whose] to be the performance of the lens of an aligner 1 and able to do a pattern in the center of a shot and the direction of an edge is different depending on exposure conditions. This display is effective in finding the exposure conditions in which a normal pattern is formed throughout the inside of a shot. Moreover, the related incidental information 54 is also outputted to a screen. Moreover, printing is also possible by clicking the printing button 55 with a mouse.

[0037] Drawing 7 shows the focal dependency in a certain measurement point (measurement pattern), and adds the specification value 61 of a size, and the specification value minimum 62, the specification value upper limit 63, the focal lower limit 64 that can form a normal pattern and the focal upper limit 65 to a graph. With this graph, change of a size becomes quite obvious, and as compared with the specification value of the measured pattern, if the optimal focus and the optimal it are which range, it can judge easily whether it is good.

[0038] Drawing 8 shows the light exposure dependency in a certain measurement point (measurement pattern), and adds the specification value 61 of a size, and the specification value minimum 62, the specification value upper limit 63, the light exposure lower limit 66 that can form a normal pattern and the light exposure upper limit 67 to a graph. With this graph, change of a size becomes quite obvious, and as compared with the specification value of the measured pattern, if the optimal light exposure and the optimal it are which range, it can judge easily whether it is good.

[0039] (Gestalt 2 of operation) Drawing 10 is the functional block diagram showing an example of the composition of exposure condition determination equipment which enforces the exposure condition determination method which is the gestalt of other operations of this invention, and the conceptual diagram drawing 11 , drawing 12 and drawing 13 , drawing 14 , and drawing 15 explain an example of the operation to be, and drawing 16 are the flow charts explaining an example of the operation.

[0040] The exposure condition determination equipment of the gestalt of this operation consists of a measurement / observation data preservation means 102 to save a measurement / observation means 101 to observe measurement and resolving for the size of a WEPA turn, size data, and the quality data of resolving, a condition calculation means 103 to compute the optimal conditions, and a condition display means 104 to display the computed conditions.

[0041] In addition, since the hardware composition of the gestalt of this operation can use each composition illustrated in the gestalt 1 of the above-mentioned operation, it quotes the composition of the gestalt 1 of operation using a corresponding sign if needed.

[0042] That is, each of these meanses are the following correspondence relations, and the composition illustrated in the gestalt 1 of the above-mentioned operation can be used for them.

[0043] For example, measurement / observation means 101 is realizable using the microscope equipments 4, such as length measurement SEM. Measurement observation data preservation means 102 is realizable using a database 9. The condition calculation means 103 is realizable as software mounted in the server 8. The condition display means 104 is realizable using the manufacture site PC 10 and an office PC 11.

[0044] First, size measurement of arbitrary patterns and resolving are observed for the wafer which changed a focus and light exposure into every exposure unit (shot 3 of a wafer 2) using the aligner 1, and burned the pattern with measurement / observation means 101, and a quality is judged. And the information measured and judged here is saved for measurement observation data preservation means 102 at any time. At this time, if the quality judging of resolving is good and it is useless in O, it saves x. And the condition calculation means 103 is beginning to read saved measurement / observation data, and performs calculation processing. And the computed exposure conditions are expressed as the condition display means 104.

[0045] Drawing 11 shows an example of record of measurement / observation data obtained by measurement / observation means 101. The rectangular head surrounded as one solid line expresses the exposure unit 105 (shot), nine kinds of different focal conditions of 0# - 8# are set up in the direction of a horizontal axis, and nine kinds of different light exposure conditions of 0# - 8# are further set up in the direction of a vertical axis. although the serration of these focal conditions and light exposure conditions is based on the resist to be used -- as an example -- focal conditions -- for example, 0.1 micrometers - 0.2 micrometers -- cutting fine -- light exposure conditions -- 200-400J/m2 It cuts fine and comes out.

[0046] Moreover, the small rectangular head divided by the dotted line in each exposure unit 105 expresses the column which records the data of each pattern. This column turns into the column 106 of a pattern P1, the column 107 of a pattern P2, the column 108 of a pattern P3, the column 109 of a pattern P4, the column 110 of pattern P5, and the column 111 of a pattern P6 from the upper left.

[0047] For example, a pattern P1 expresses the line & space where a pattern P3 is parallel to the direction of Y for the line & space where a pattern P2 is parallel to the direction of X of the direction of X-Y of the wafer stage of an aligner 1, and a pattern P4 expresses each imprint pattern and its observation result of line & space ** of the direction of slant for a hole pattern.

[0048] Even if there are more patterns measured and observed in this example although record to six kinds of patterns is possible in one exposure unit 105 than it, they are good at least. The these-collected data are related with a focus and light exposure, are carried out, and are saved for measurement / observation data preservation means 102.

[0049] Drawing 12 shows how to compute the optimal exposure conditions. the shaft of two-dimensional system of coordinates -- a focus and light exposure -- taking -- the system of coordinates -- patterns P1-P6 -- respectively -- ** -- it is alike and a size and resolving describe the good range At this time, as for the point used as a boundary, a size and a judgment describe the range with the circle of the approximation at O which considers as outside conditions most and surrounds it for a point inside to the shaft of a focus and light exposure.

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is explanatory drawing showing the outline of the exposure condition determination support method and the system configuration of a sake of the gestalt of 1 operation of this invention.
[Drawing 2] It is drawing showing the display screen of the picture doubled with the list of the shot on a wafer, and a size and a judgment.
[Drawing 3] It is drawing showing the display screen which put a picture, and a size and a judgment in order on the measurement point to the focus.
[Drawing 4] It is drawing showing the display screen which put a picture, and a size and a judgment in order on the measurement point to light exposure.
[Drawing 5] It is drawing showing the display screen which carried out the enlarged display of the picture.
[Drawing 6] It is drawing showing the display screen which put the picture in order according to the measurement point in a shot.
[Drawing 7] It is drawing showing the focal dependency in a certain measurement point.
[Drawing 8] It is drawing showing the light exposure dependency in a certain measurement point.
[Drawing 9] It is drawing showing an example of the sheet which records a size, a judgment, etc. in a Prior art.
[Drawing 10] It is the functional block diagram showing an example of the composition of exposure condition determination equipment which enforces the exposure condition determination method which is the gestalt of other operations of this invention.
[Drawing 11] It is a conceptual diagram explaining an example of the operation.
[Drawing 12] It is a conceptual diagram explaining an example of the operation.
[Drawing 13] It is a conceptual diagram explaining an example of the operation.
[Drawing 14] It is a conceptual diagram explaining an example of the operation.
[Drawing 15] It is a conceptual diagram explaining an example of the operation.
[Drawing 16] It is a flow chart explaining an example of the operation.
[Description of Notations]
1 Aligner
2 Wafer
3 Shot
4 Microscope Equipment
5 Screen
6 Microscope Picture
7 Measurement Information

7a Pattern judging
8 Server
9 Database
10 Manufacture Site PC
11 Office PC
12 Picture List
13 Focal Dependency
14 Light Exposure Dependency
15 Index Information
16 Focal Value
17 Light Exposure
18 Picture
19 Size Value
20 Pattern Judging
21 Left 1 Data Scrolling Button
22 Left 1 Page Scrolling Button
23 Right 1 Data Scrolling Button
24 Right 1 Page Scrolling Button
25 Upper 1 Data Scrolling Button
26 Upper 1 Page Scrolling Button
27 Lower 1 Data Scrolling Button
28 Lower 1 Page Scrolling Button
29 Change-under Measurement Point Button
30 Change-on Measurement Point Button
31 Printing Button
32 Comment Input Field
33 Measurement Point
34 Change-under Light Exposure Button
35 Change-on Light Exposure Button
36 Change-under Focus Button
37 Change-on Focus Button
38 Expansion Picture
39 Incidental Information
40 Image File Name Input Field
41 Judgment Field
42 Preservation Button
43 Printing Button
44 Shot Upper Left Picture
45 Shot Nakagami Picture
46 Shot Upper Right Picture
47 Picture in Shot Left
48 Picture in Inside of Shot
49 Picture in Shot Right
50 Shot Lower Left Picture
51 Shot Nakashita Picture
52 Shot Lower Right Picture
53 Coordinate
54 Incidental Information

55 Printing Button
61 Specification Value
62 Specification Value Minimum
63 Specification Value Upper Limit
64 Focal Lower Limit
65 Focal Upper Limit
66 Light Exposure Lower Limit
67 Light Exposure Upper Limit
68 Exposure Pattern (Circle as an Example)
69 Network
101 Measurement / Observation Means
102 Measurement / Observation Data Preservation Means
103 Condition Calculation Means
104 Condition Display Means
105 Exposure Unit
106 Column
107 Column
108 Column
109 Column
110 Column
111 Column
112 Size and Resolving Good Range for Every Pattern
113 Size and Resolving Good Range for Every Pattern
114 Size and Resolving Good Range for Every Pattern
115 Size and Resolving Good Range for Every Pattern
116 Size and Resolving Good Range for Every Pattern
117 Common Size and Resolving Good Range
118 Optimum Conditions
200 Measurement Result File
201 Shot ID Field
202 Pattern ID Field
203 Judgment Result Field
300 Comprehensive Judgment Result Bit Map
301-306 Judgment result bit map
P1-P6 Pattern

[Translation done.]

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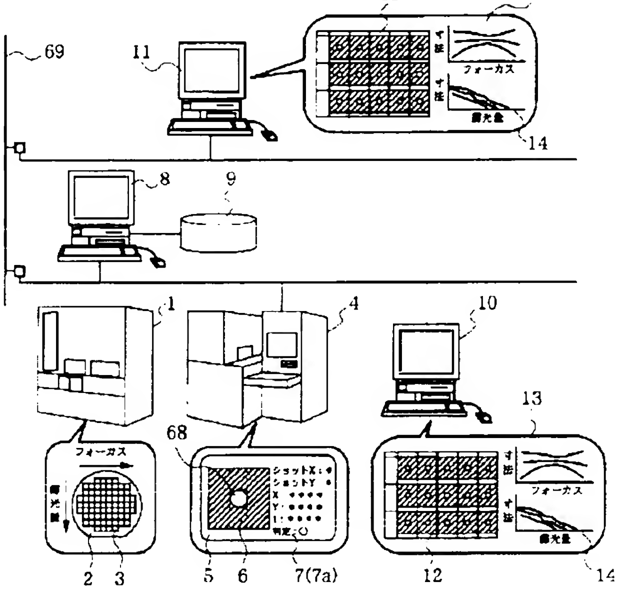
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

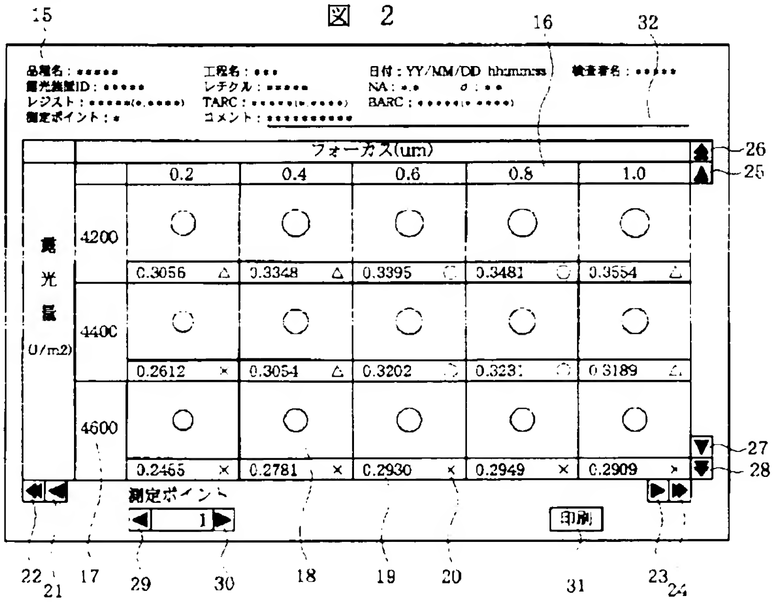
[Drawing 1]

図 1


12
13
69
11
寸法
フォーカス
寸法
露光量
14
8
9
1
4
10
13
68
フォーカス
露光量
ショットX
ショットY
X
Y
I
判定
寸法
フォーカス
寸法
露光量
2
3
5
6
7(7a)
12
14

[Drawing 2]

図 2


15
16
32
26
25
27
28
22
21
17
29
30
18
19
20
31
23
24
◀◀ ◀
▶ ▶▶
印刷

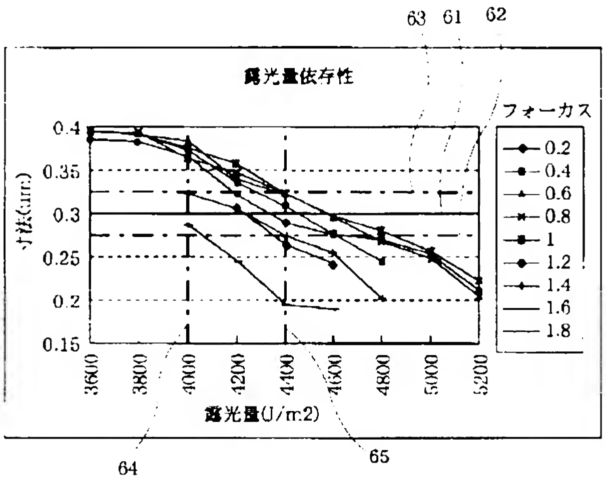
品種名 : *****
露光装置ID : *****
レジスト : *****(*.****)
測定ポイント : *
工程名 : ***
レチクル : *****
TARC : *****(*.****)
コメント : **********
日付 : YY/MM/DD hh:mm:ss
NA : *.*　σ : *.*
BARC : *****(*.****)
検査者名 : *****

		フォーカス(um)				
		0.2	0.4	0.6	0.8	1.0
露光量(J/m2)	4200	0.3056 △	0.3348 △	0.3395 ○	0.3481 ○	0.3554 △
	4400	0.2612 ×	0.3054 △	0.3202 ○	0.3231 ○	0.3189 △
	4600	0.2465 ×	0.2781 ×	0.2930 ×	0.2949 ×	0.2909 ×

測定ポイント ◀ 1 ▶

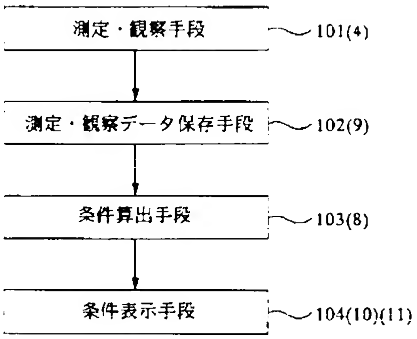
[Drawing 8]

図 8



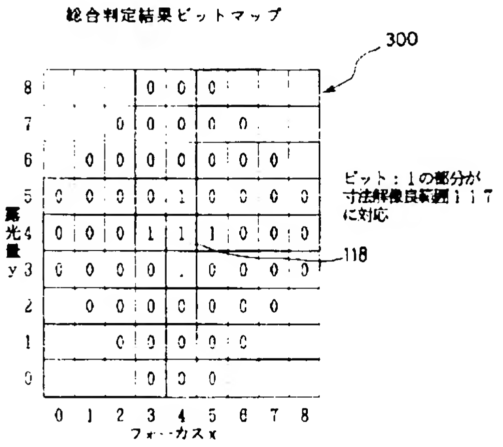
[Drawing 10]

図 10


測定・観察手段
101(4)
測定・観察データ保存手段
102(9)
条件算出手段
103(8)
条件表示手段
104(10)(11)

[Drawing 15]

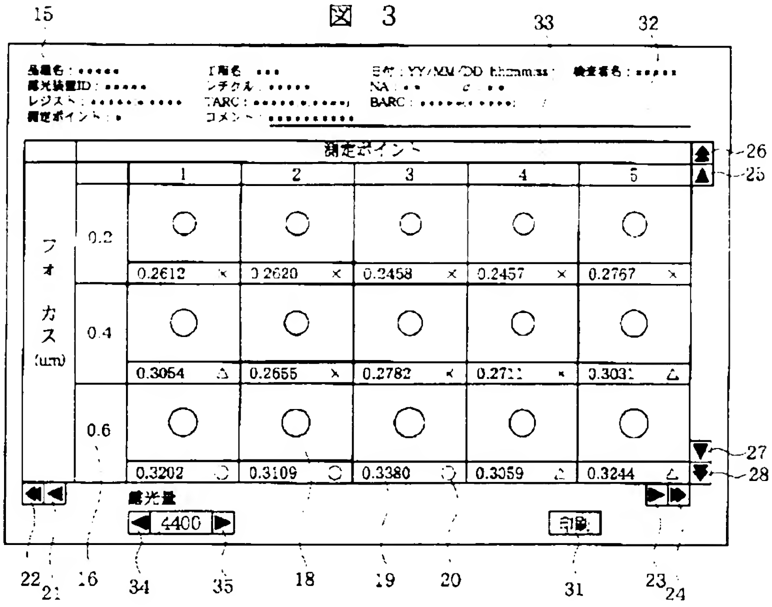
図１５


総合判定結果ビットマップ
300
ビット：１の部分が
寸法解像良範囲１１７
に対応
118
露光量y
フォーカスx

露光量y	0	1	2	3	4	5	6	7	8
8				0	0	0			
7			0	0	0	0	0		
6		0	0	0	0	0	0	0	
5	0	0	0	0	1	0	0	0	0
4	0	0	0	1	1	1	0	0	0
3	0	0	0	0	.	0	0	0	0
2		0	0	0	0	0	0	0	
1			0	0	0	0	0		
0				0	0	0			

[Drawing 3]

図 3

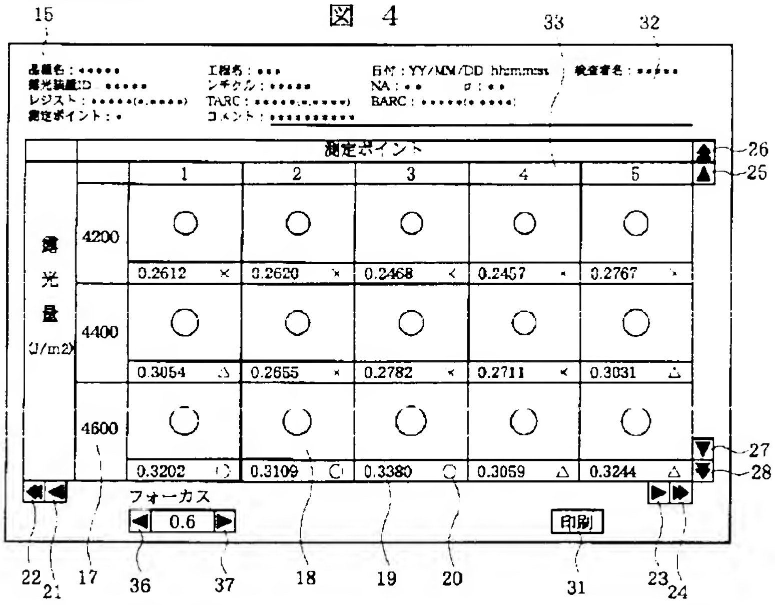

15
33
32
26
25
27
28
22
21
16
34
35
18
19
20
31
23
24
露光量
4400
印刷

品種名：●●●●●
工程名：●●●
日付：YY/MM/DD hh:mm:ss
検査者名：●●●●●
露光装置ID：●●●●●
レチクル：●●●●●
NA：●●
σ：●●
レジスト：●●●●●(●.●●●●)
TARC：●●●●●(●.●●●●)
BARC：●●●●●(●.●●●●)
測定ポイント：●
コメント：●●●●●●●●●●

フォーカス (um)	測定ポイント 1	2	3	4	5
0.2	0.2612 ×	0.2620 ×	0.2458 ×	0.2457 ×	0.2767 ×
0.4	0.3054 △	0.2655 ×	0.2782 ×	0.2711 ×	0.3031 △
0.6	0.3202 ○	0.3109 ○	0.3380 ○	0.3059 △	0.3244 △

[Drawing 4]

図 4

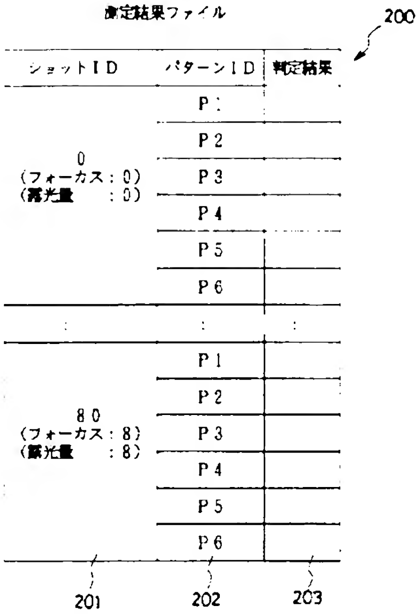

15
33
32
26
25
27
28
22
21
17
36
37
18
19
20
31
23
24
フォーカス
0.6
印刷

品種名：●●●●●
工程名：●●●
日付：YY/MM/DD hh:mm:ss
検査者名：●●●●●
露光装置ID：●●●●●
レチクル：●●●●●
NA：●●
σ：●●
レジスト：●●●●●(●.●●●●)
TARC：●●●●●(●.●●●●)
BARC：●●●●●(●.●●●●)
測定ポイント：●
コメント：●●●●●●●●●●

露光量 (J/m2)	測定ポイント 1	2	3	4	5
4200	0.2612 ×	0.2620 ×	0.2468 ×	0.2457 ×	0.2767 ×
4400	0.3054 △	0.2655 ×	0.2782 ×	0.2711 ×	0.3031 △
4600	0.3202 ○	0.3109 ○	0.3380 ○	0.3059 △	0.3244 △

[Drawing 13]

図13

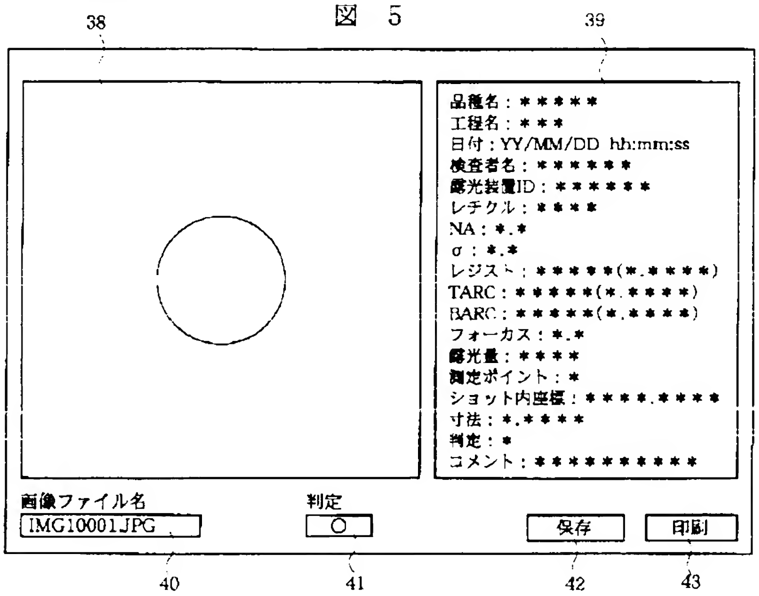

測定結果ファイル

ショットID	パターンID	判定結果
0 （フォーカス：0） （露光量　：0）	P1	
	P2	
	P3	
	P4	
	P5	
	P6	
：	：	：
80 （フォーカス：8） （露光量　：8）	P1	
	P2	
	P3	
	P4	
	P5	
	P6	

200
201
202
203

[Drawing 5]

図　5

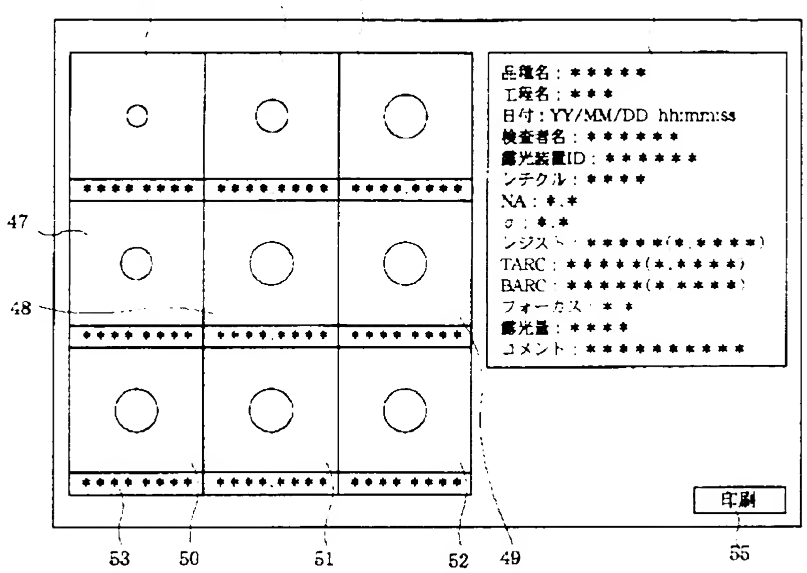

品種名：*****
工程名：***
日付：YY/MM/DD hh:mm:ss
検査者名：******
露光装置ID：******
レチクル：****
NA：*.*
σ：*.*
レジスト：*****(*.****)
TARC：*****(*.****)
BARC：*****(*.****)
フォーカス：*.*
露光量：****
測定ポイント：*
ショット内座標：****.****
寸法：*.****
判定：*
コメント：**********

画像ファイル名：IMG10001JPG
判定：○

38
39
保存
印刷
40
41
42
43

[Drawing 6]

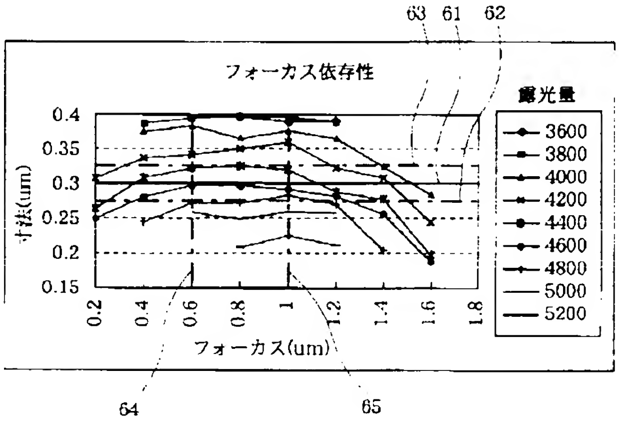
図 6


44
45
46
54
47
48
印刷
53
50
51
52
49
55

品種名 : *****
工程名 : ***
日付 : YY/MM/DD hh:mm:ss
検査者名 : ******
露光装置ID : ******
レチクル : ****
NA : *.*
σ : *.*
レジスト : *****(*.****)
TARC : *****(*.****)
BARC : *****(*.****)
フォーカス : *.*
露光量 : ****
コメント : **********

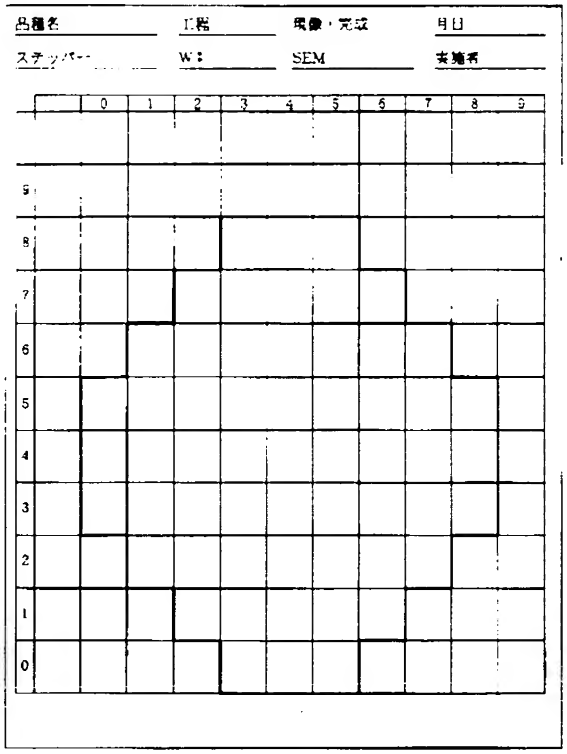
[Drawing 7]

図 7



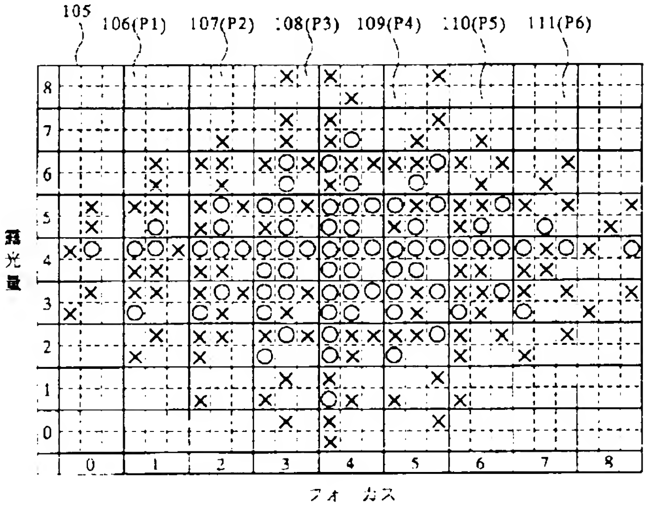
[Drawing 9]

図 9


品種名
工程
現像・完成
月日
ステッパー
W:
SEM
実施者
0
1
2
3
4
5
6
7
8
9

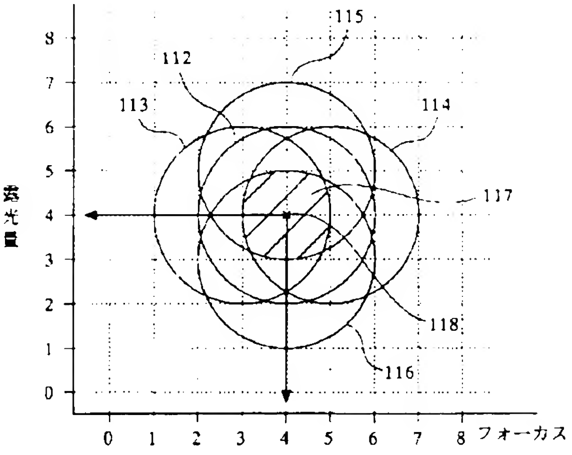
[Drawing 11]

図 11



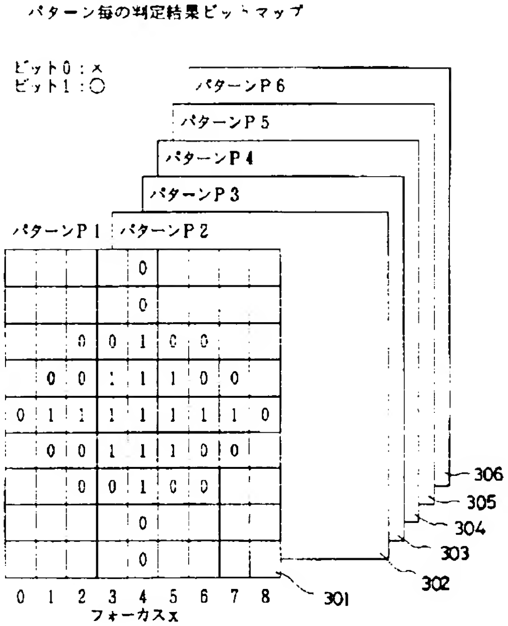
[Drawing 12]

図 12


115
112
113
114
117
118
116
露光量
8
7
6
5
4
3
2
1
0
0 1 2 3 4 5 6 7 8
フォーカス

[Drawing 14]

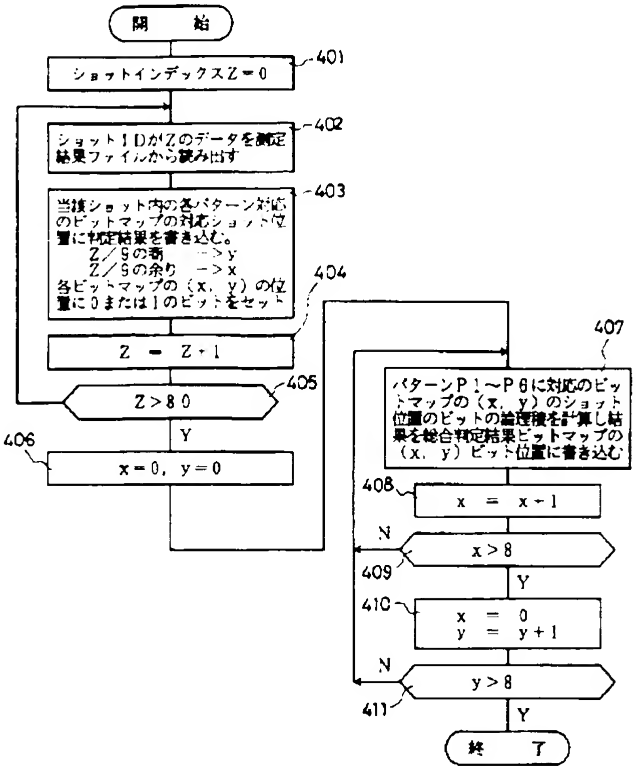
図１４


パターン毎の判定結果ビットマップ
ビット0：×
ビット1：○
パターンP６
パターンP５
パターンP４
パターンP３
パターンP１
パターンP２
露光量y
フォーカスx
306
305
304
303
302
301

露光量y	0	1	2	3	4	5	6	7	8
8					0				
7					0				
6			0	0	1	0	0		
5		0	0	1	1	1	0	0	
4	0	1	1	1	1	1	1	1	0
3		0	0	1	1	1	0	0	
2			0	0	1	0	0		
1					0				
0					0				

[Drawing 16]

図１６


開始
ショットインデックスZ＝0
401
ショット１ＤがZのデータを測定結果ファイルから読み出す
402
当該ショット内の各パターン対応のビットマップの対応ショット位置に判定結果を書き込む。
Z／9の商 －＞y
Z／9の余り －＞x
各ビットマップの（x，y）の位置に0または1のビットをセット
403
Z ＝ Z＋1
404
Z＞80
405
Y
x＝0，y＝0
406
パターンＰ１～Ｐ８に対応のビットマップの（x，y）のショット位置のビットの論理積を計算し結果を総合判定結果ビットマップの（x，y）ビット位置に書き込む
407
x ＝ x＋1
408
N
x＞8
409
Y
x ＝ 0
y ＝ y＋1
410
N
y＞8
411
Y
終了

[Translation done.]